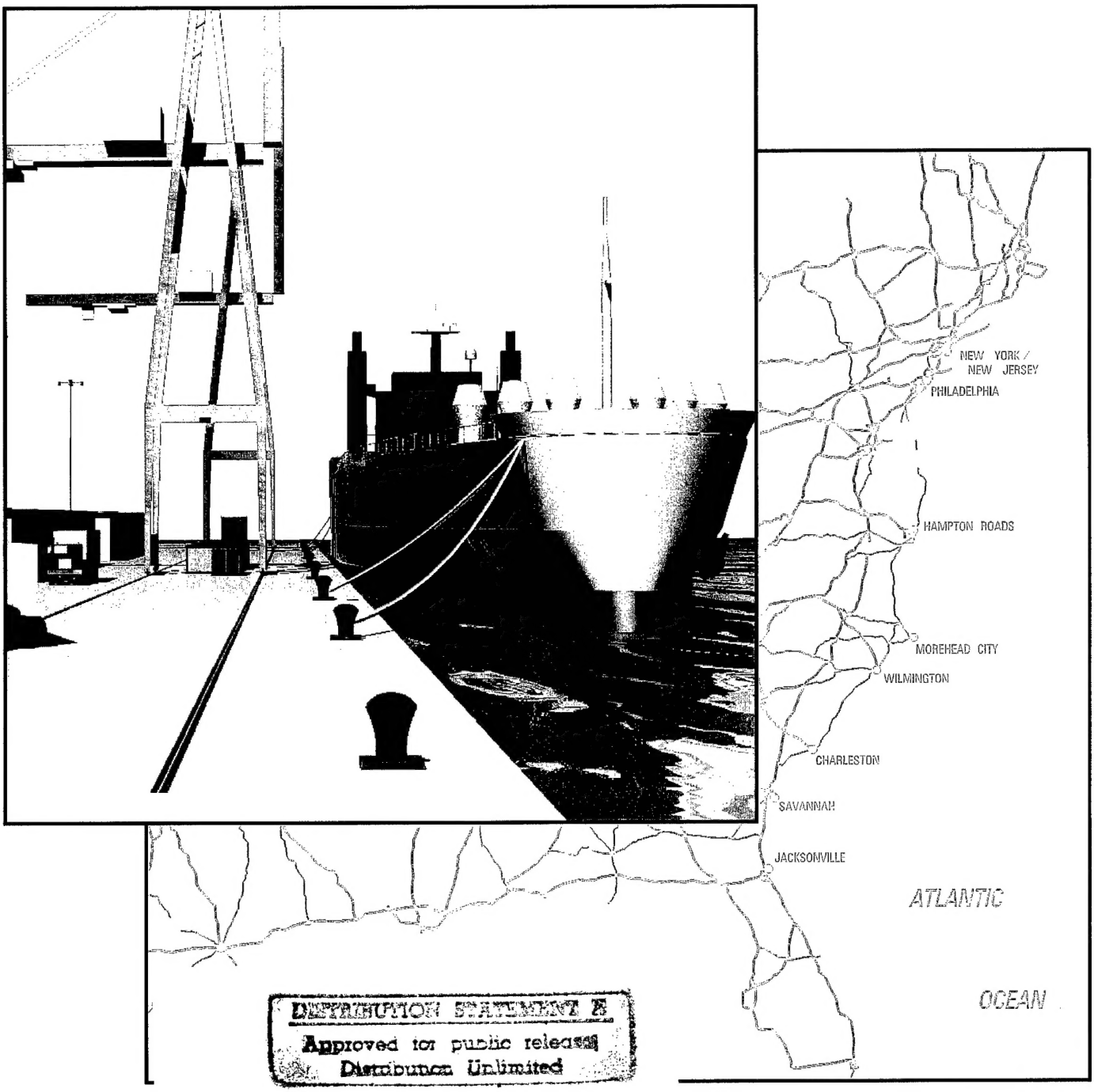
MTMCTEA Report INF 95–07

EAST COAST

PORTS FOR NATIONAL DEFENSE



Military Traffic Management Command
Transportation Engineering Agency

East Coast Ports

March 1996

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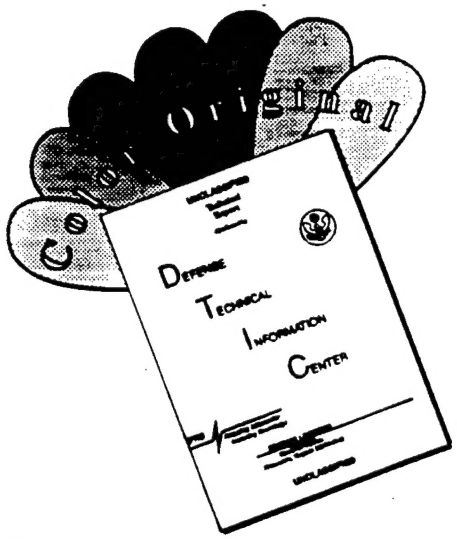

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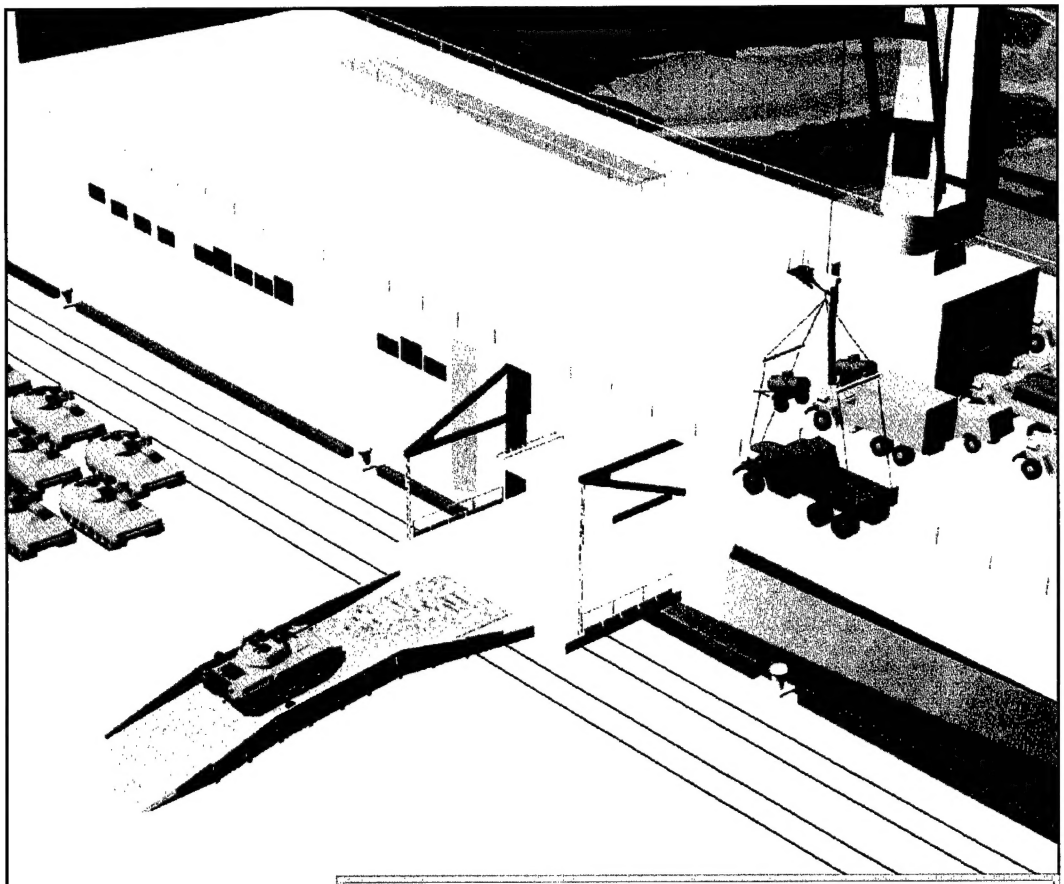


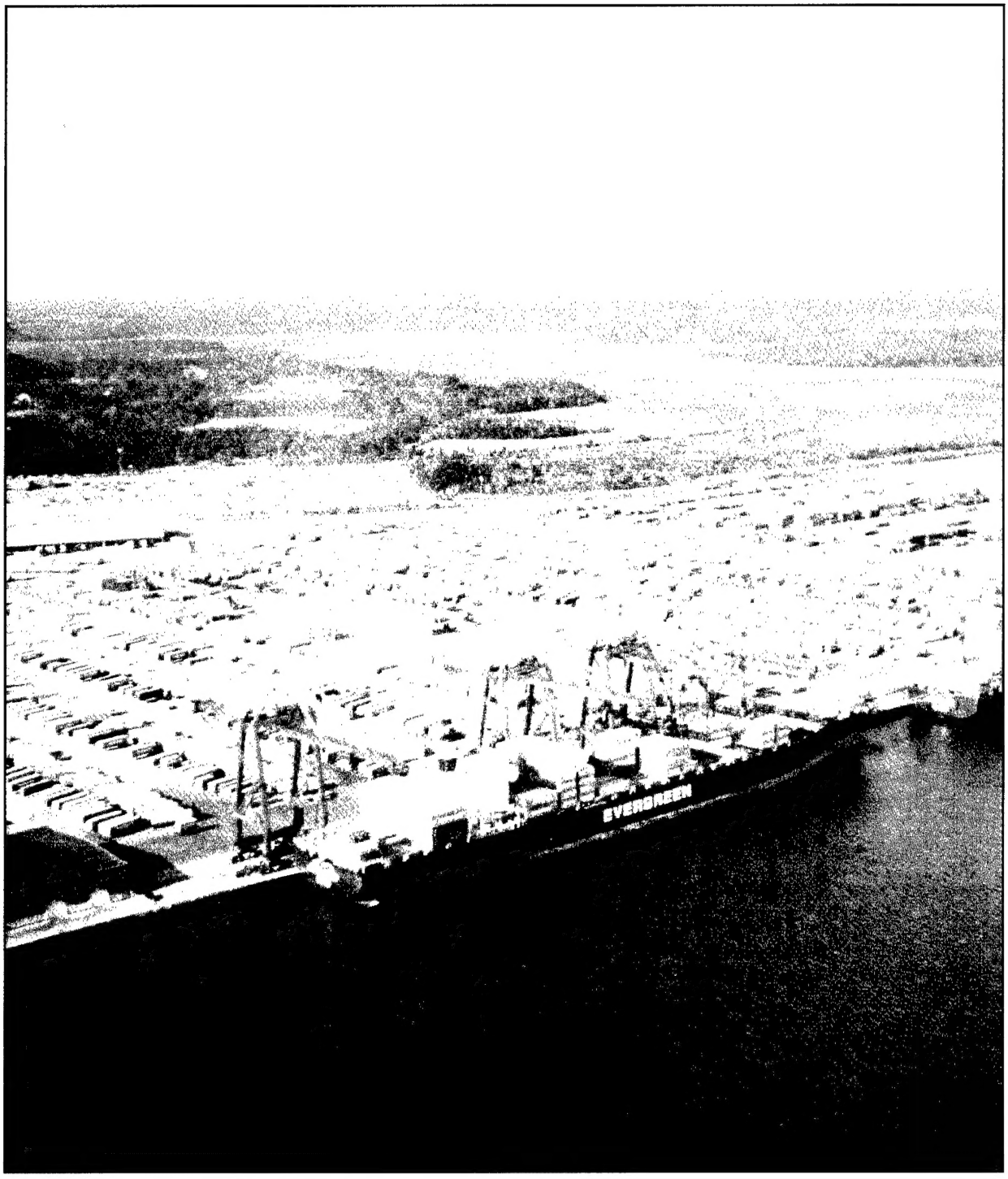
As part of the ongoing Ports for National Defense (PND) Program, the Military Traffic Management Command Transportation Engineering Agency (MTMCTEA) revised information for selected east coast ports. The objectives of this report are to:

- *Identify* the port facilities and equipment needed to support a deployment.
- *Determine* the port throughput capability in MTON per day.
- *Determine* the ability of MARAD designated facilities to meet the deployment of specific units.

SUMMARY OF BERTH THROUGHPUTS

East Coast Ports	Totals for Entire Port			Port Planning Orders		
	Depth/s (ft-MLW)	Wharfage (ft)	Throughput (STON/ MTON)	Depth/s (ft-MLW)	Wharfage (ft)	Throughput (STON/ MTON)
Charleston	40	13,871	32,000/ 101,000	40	2,460	6,800/ 22,000
Hampton Roads	28-45	22,287	52,000/ 167,000	32-39	7,361	18,000/ 54,000
Jacksonville	38	10,000	25,000/ 88,000	38	3,000	8,300/ 29,000
Morehead City	35-45	5,550	6,600/ 20,000	35	2,700	4,000/ 13,000
New York/ New Jersey	32-40	45,000	110,000/ 380,000	40	2,000	6,700/ 22,000
Philadelphia	30-40	17,228	35,000/ 110,000	N/A		
Savannah	38-42	10,184	23,000/ 73,000	42	3,000	7,600/ 19,000
Wilmington	38	6,863	12,000/ 38,000	38	1,813	3,000/ 10,000

PORT OF CHARLESTON, SC



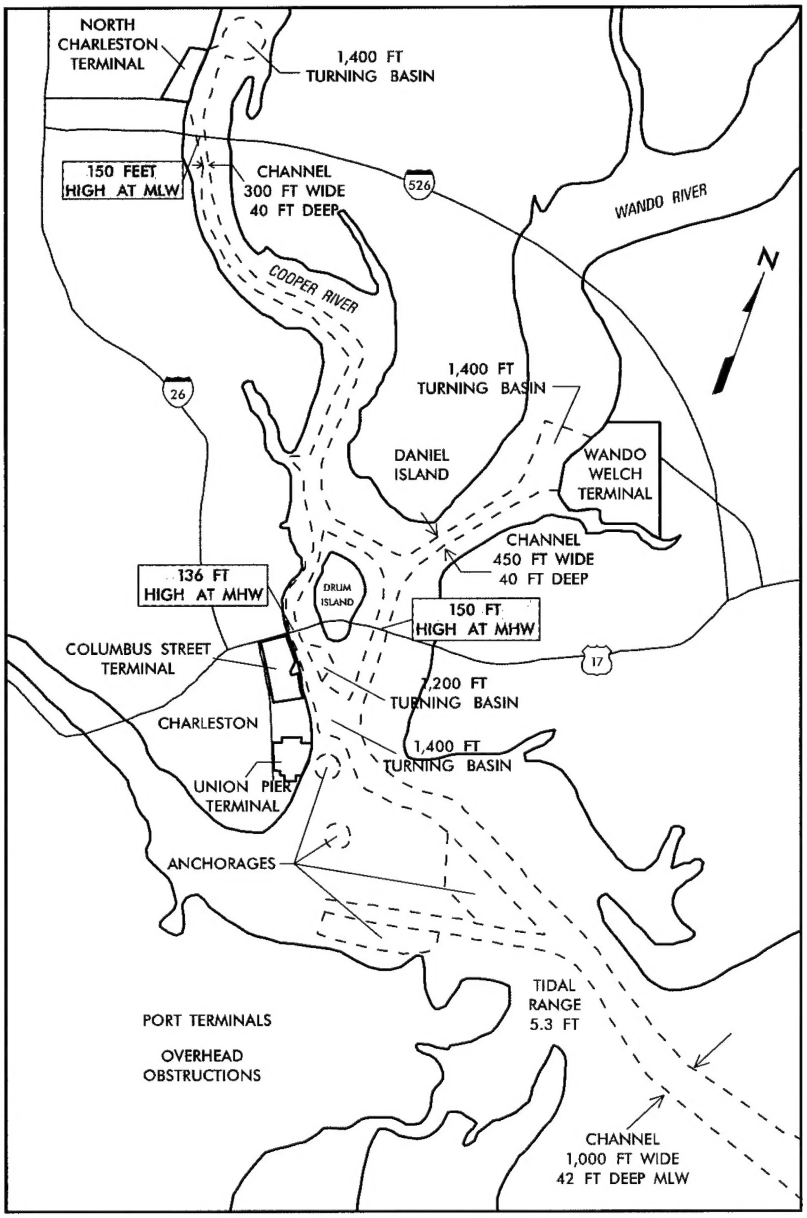
I. GENERAL DATA

TRANSPORTATION ACCESS

Water

The terminals of the Port of Charleston are within 2 hours sailing time from the Atlantic Ocean. Four anchorages and four turning basins are in the harbor area. Three bridges cross the channel to the North Charleston Terminal and the adjacent South Atlantic Outport. The first two bridges, just above Columbus Street Terminal, are side by side with an overhead clearance of 150 feet high at mean high water (MHW), with 1,000 feet of deep channel width. The third bridge is just below the North Charleston Terminal, on Interstate 526 (I-526). It is 150 feet above the water at MHW, with 300 feet of deep channel width.

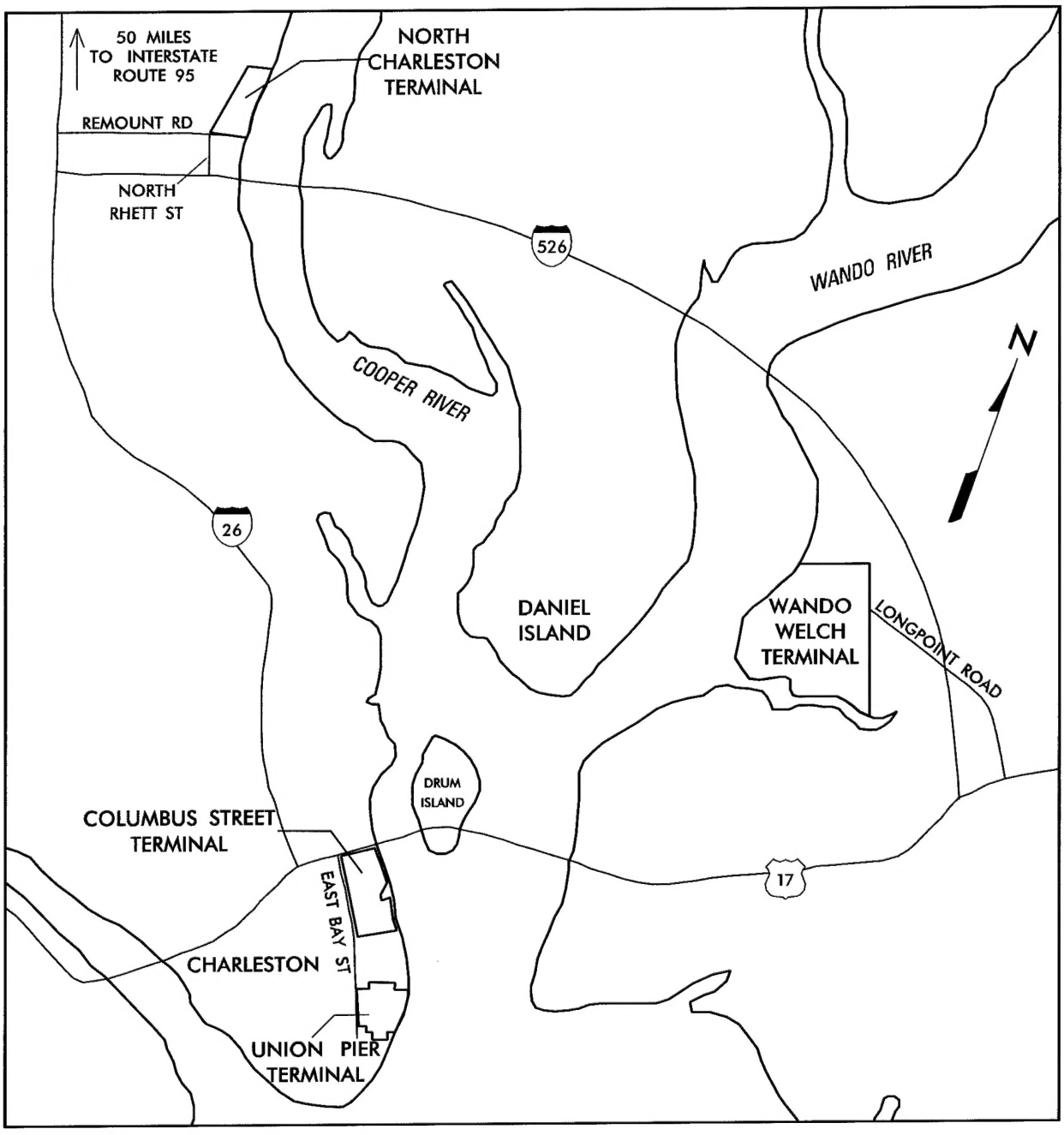
All channels are at least 40 feet deep at mean low water (MLW). The channel near the entrance is 42 feet deep.



Water Access

Highway

The major highway to the Port of Charleston from the northwest is Interstate Route 26 (I-26). Charleston is about 50 miles from Interstate Route 95 (I-95), the major east coast north-south artery. US Route 17 connects Charleston with nearby coastal cities.



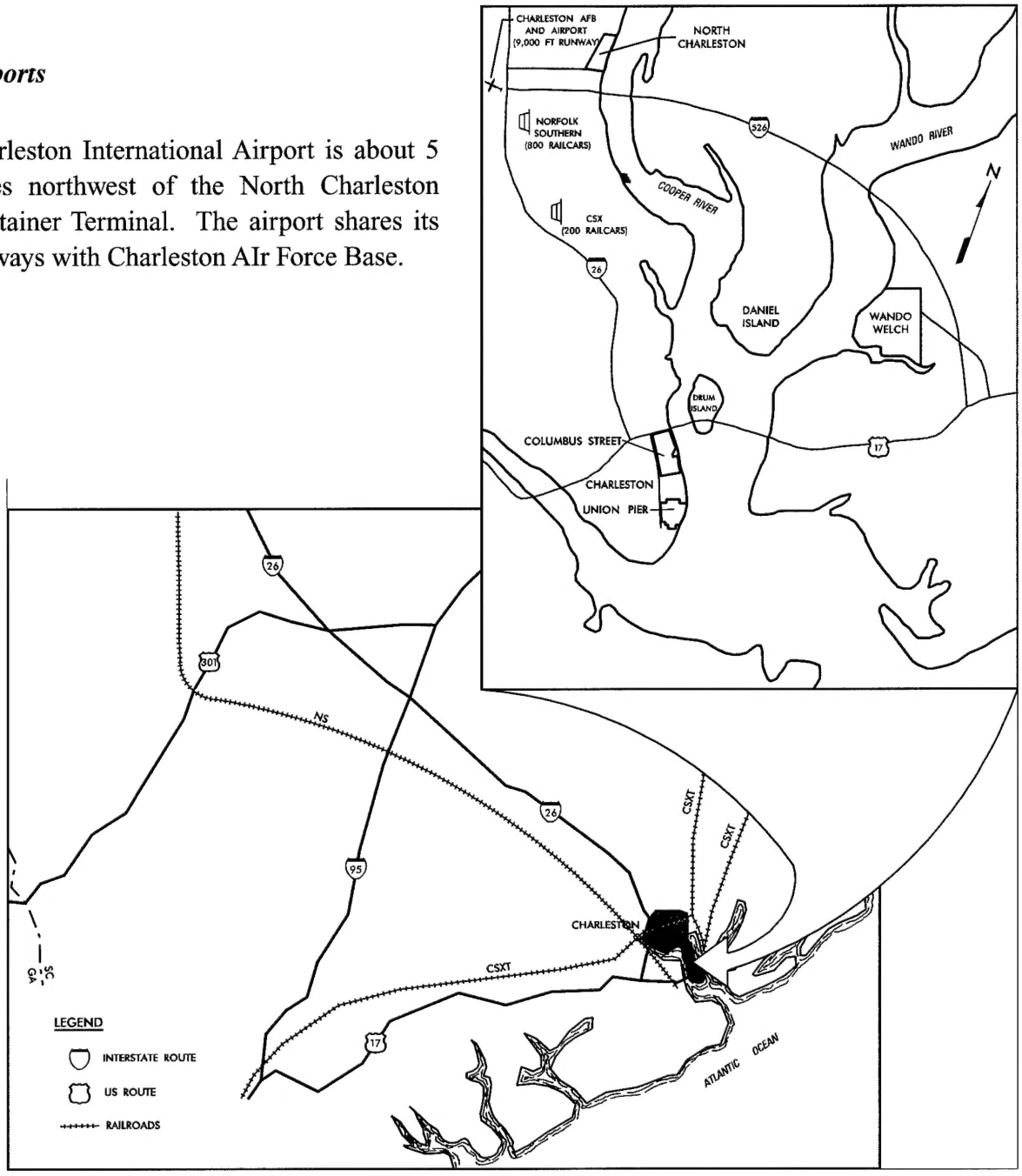
Highway Access

Rail

Norfolk Southern and FSX provide rail serviceto the Port of Charleston. These major railyards are in the port area. Two are located 2 miles southwest of the North Charleston Terminal. Inter/ intra terminal switching is handled by the South Carolina Public Railways Commission's switch locomotives, except at the MTMC South Atlantic Outport, at the north end of North Carleston Terminal.

Airports

Charleston International Airport is about 5 miles northwest of the North Charleston Container Terminal. The airport shares its runways with Charleston AIr Force Base.



Rail and Air Access

PORT FACILITIES

Berthing

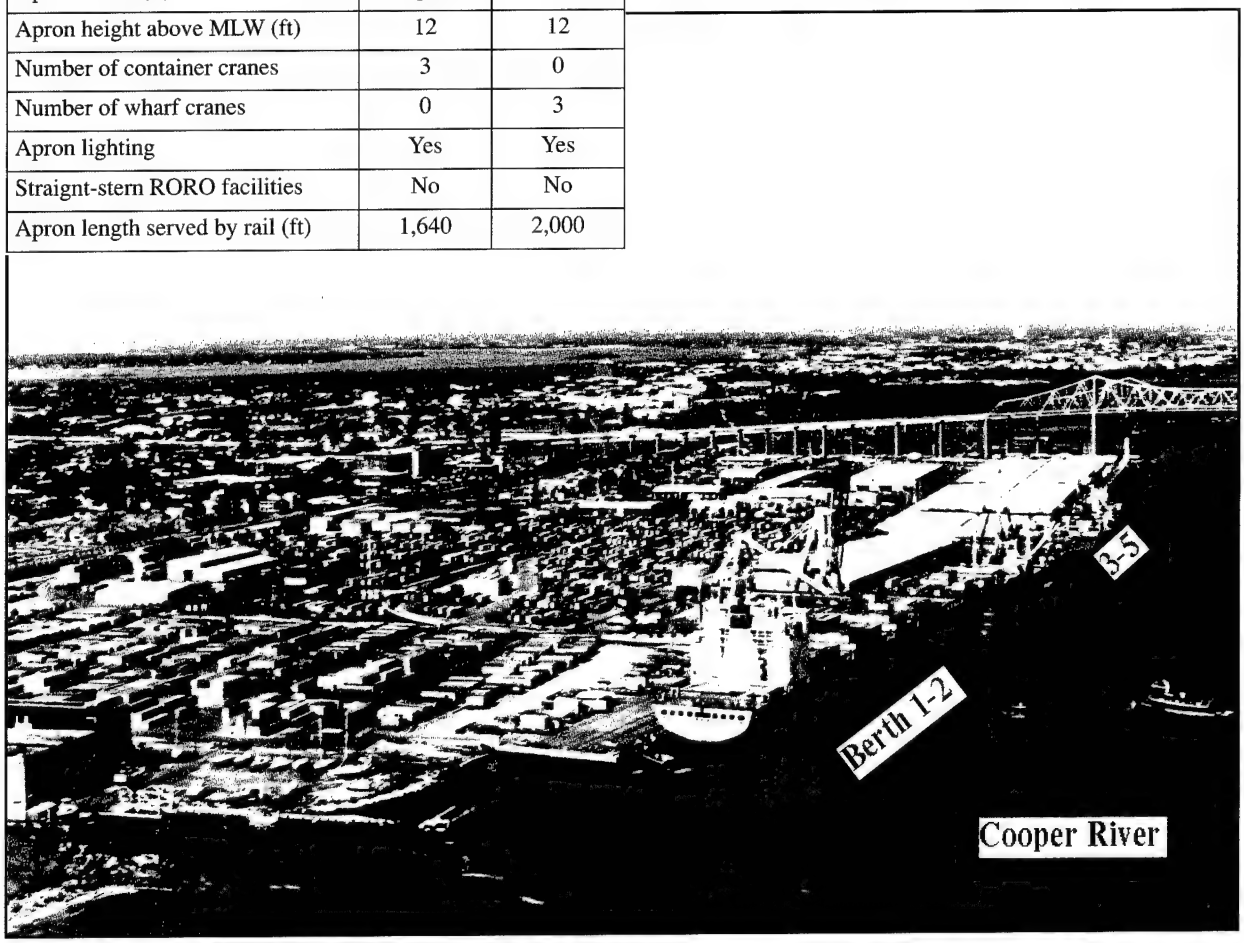
This report covers Columbus Street, Union Pier, North Charleston, and Wando Welch Terminals. These terminals are suitable for military operations. Union Pier is generally a breakbulk facility, with transit sheds along most of the wharf. All other terminals handle containers, with few or no transit sheds.

BERTHING CHARACTERISTICS OF COLUMBUS STREET TERMINAL

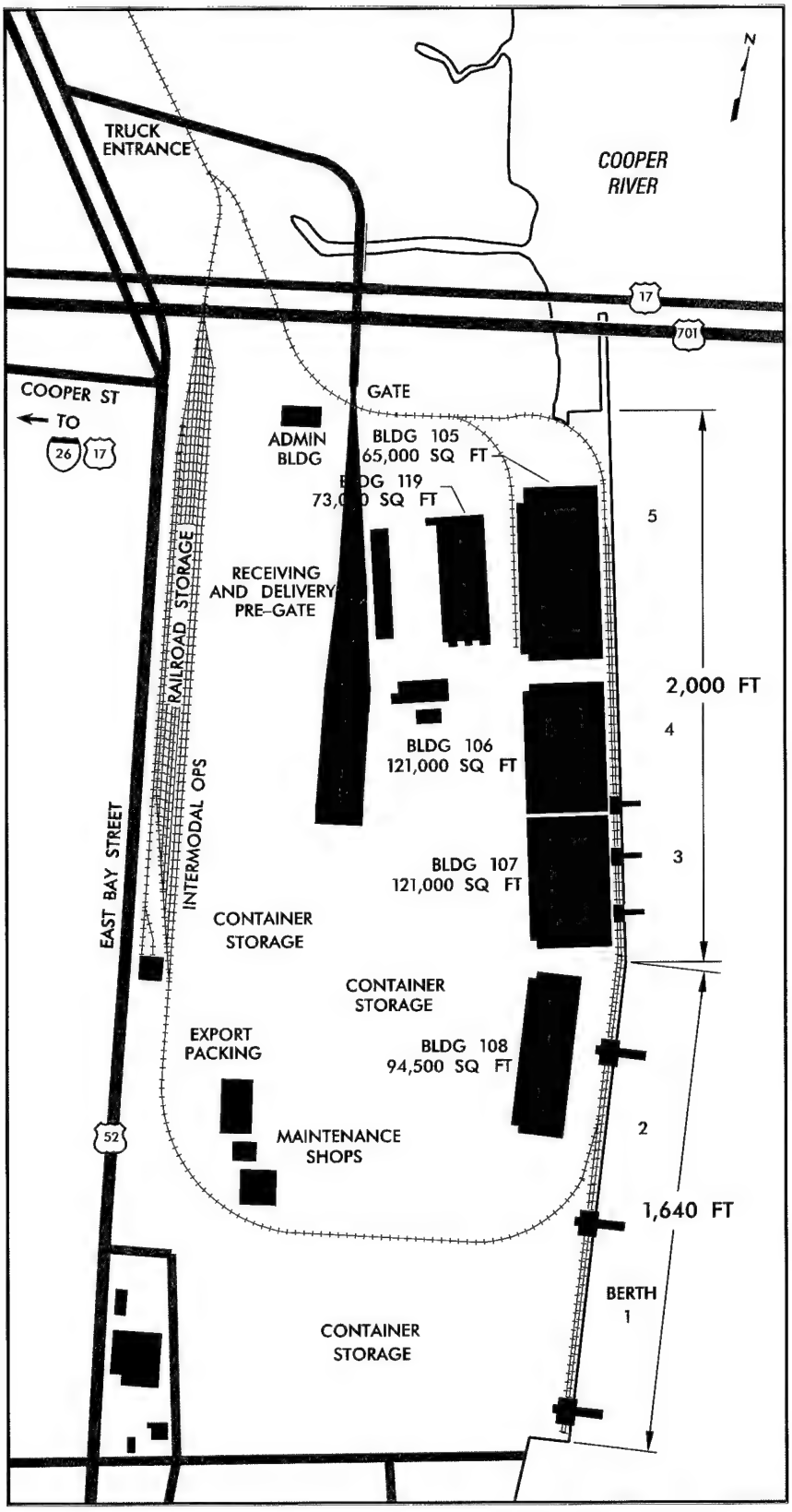
Characteristics	Berths	
	1-2	3-4
Length (ft)	1,640	2,000
Depth alongside at MLW (ft)	40	40
Deck strength (psf)	1,000	600
Apron width (ft)	Open	45
Apron height above MLW (ft)	12	12
Number of container cranes	3	0
Number of wharf cranes	0	3
Apron lighting	Yes	Yes
Straignt-stern RORO facilities	No	No
Apron length served by rail (ft)	1,640	2,000

Pier construction is generally concrete piles, with concrete decking, and timber fenders. All terminals have lighting for night operations.

Below are land-use maps and aerial views of the terminals. Tables identify berth characteristics.

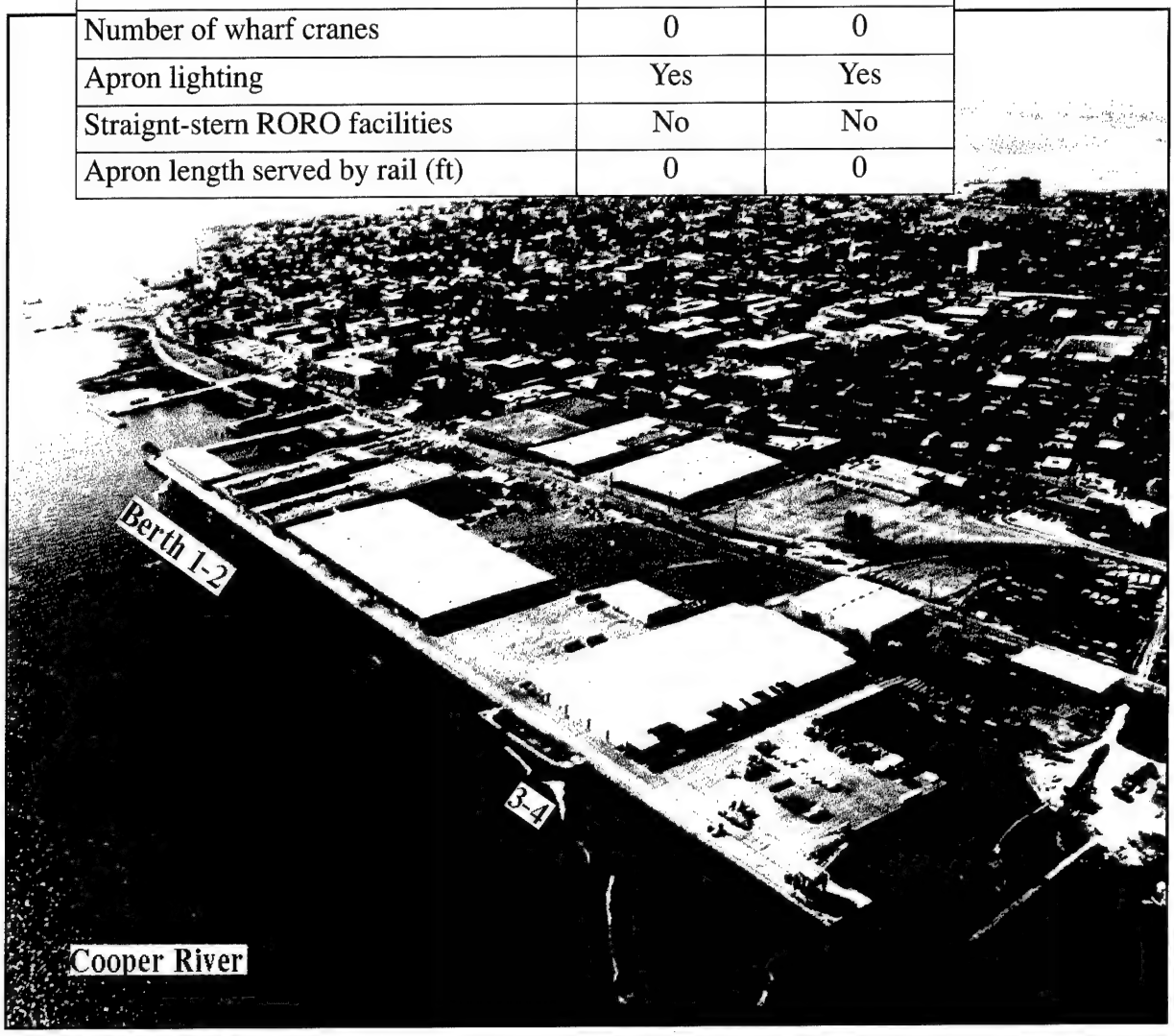


Columbus Street Terminal (Northeastward view)

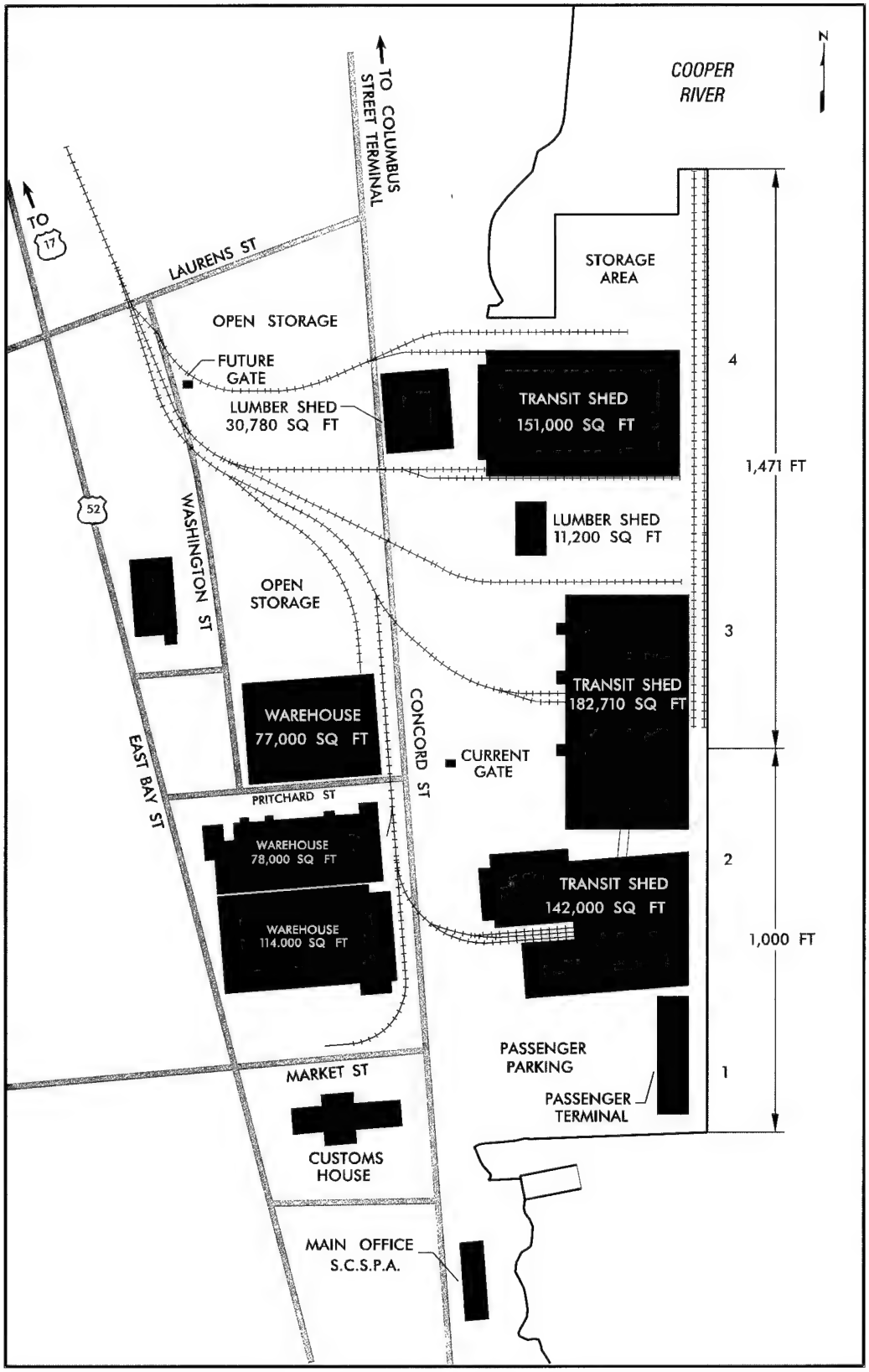


Columbus Street Terminal Land-Use Map

BERTHING CHARACTERISTICS OF UNION PIER TERMINAL		
Characteristics	**Berths**	
	1-2	**3-4**
Length (ft)	1,000	1,471
Depth alongside at MLW (ft)	40	40
Deck strength (psf)	400	1,000
Apron width (ft)	45	Open
Apron height above MLW (ft)	12	12
Number of container cranes	0	0
Number of wharf cranes	0	0
Apron lighting	Yes	Yes
Straignt-stern RORO facilities	No	No
Apron length served by rail (ft)	0	0

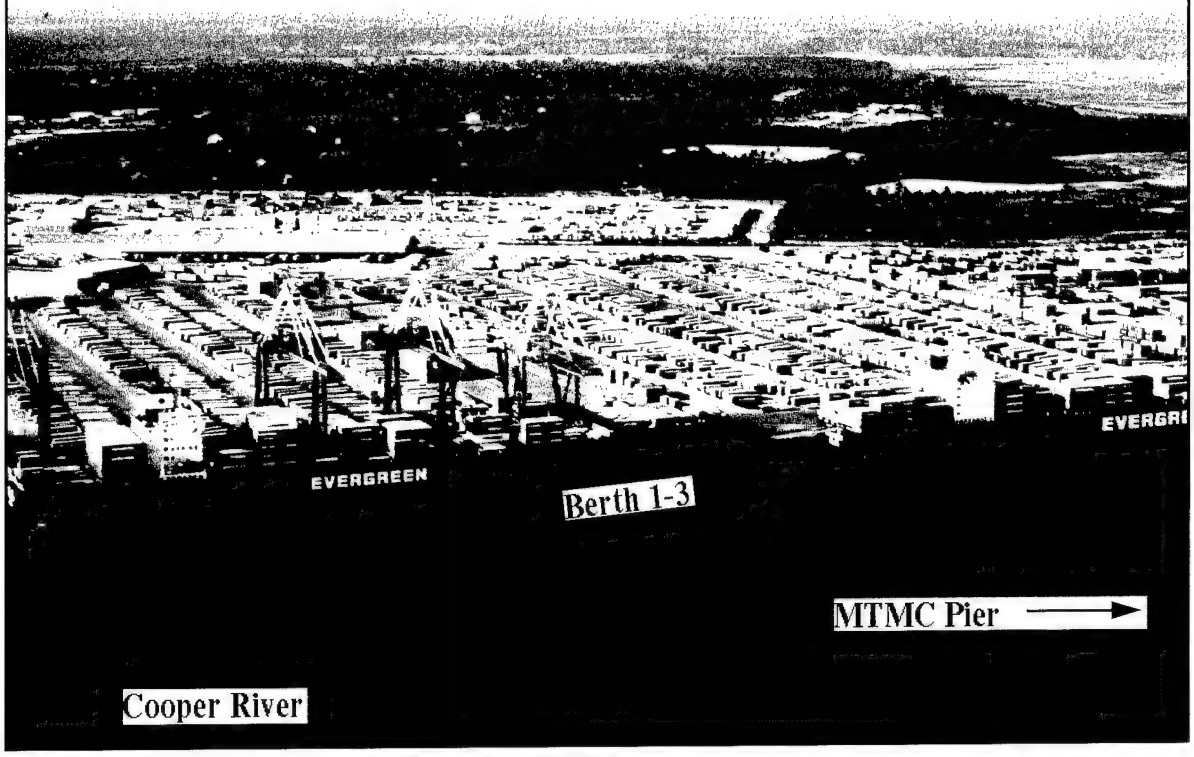


Union Pier Terminal (Southwestward view)

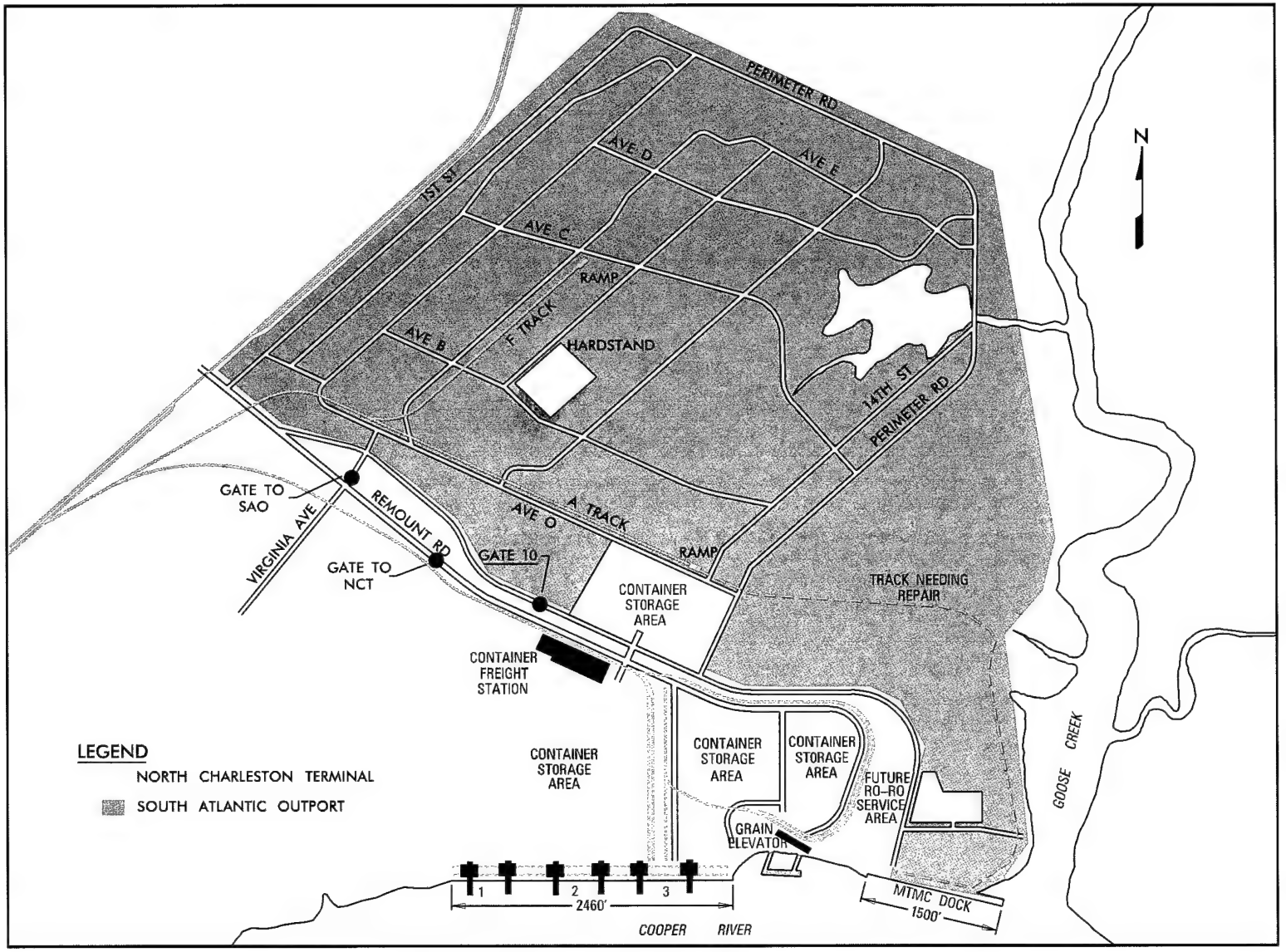


Union Pier Land-Use Map

BERTHING CHARACTERISTICS OF NORTH CHARLESTON TERMINAL		
Characteristics	**Berths**	
	1-3	**MTMC**
Length (ft)	2,460	1,500
Depth alongside at MLW (ft)	40	40
Deck strength (psf)	1,000	700
Apron width (ft)	100	100
Apron height above MLW (ft)	12	12
Number of container cranes	6	0
Number of wharf cranes	0	0
Apron lighting	Yes	Yes
Straignt-stern RORO facilities	No	No
Apron length served by rail (ft)	0	1,500

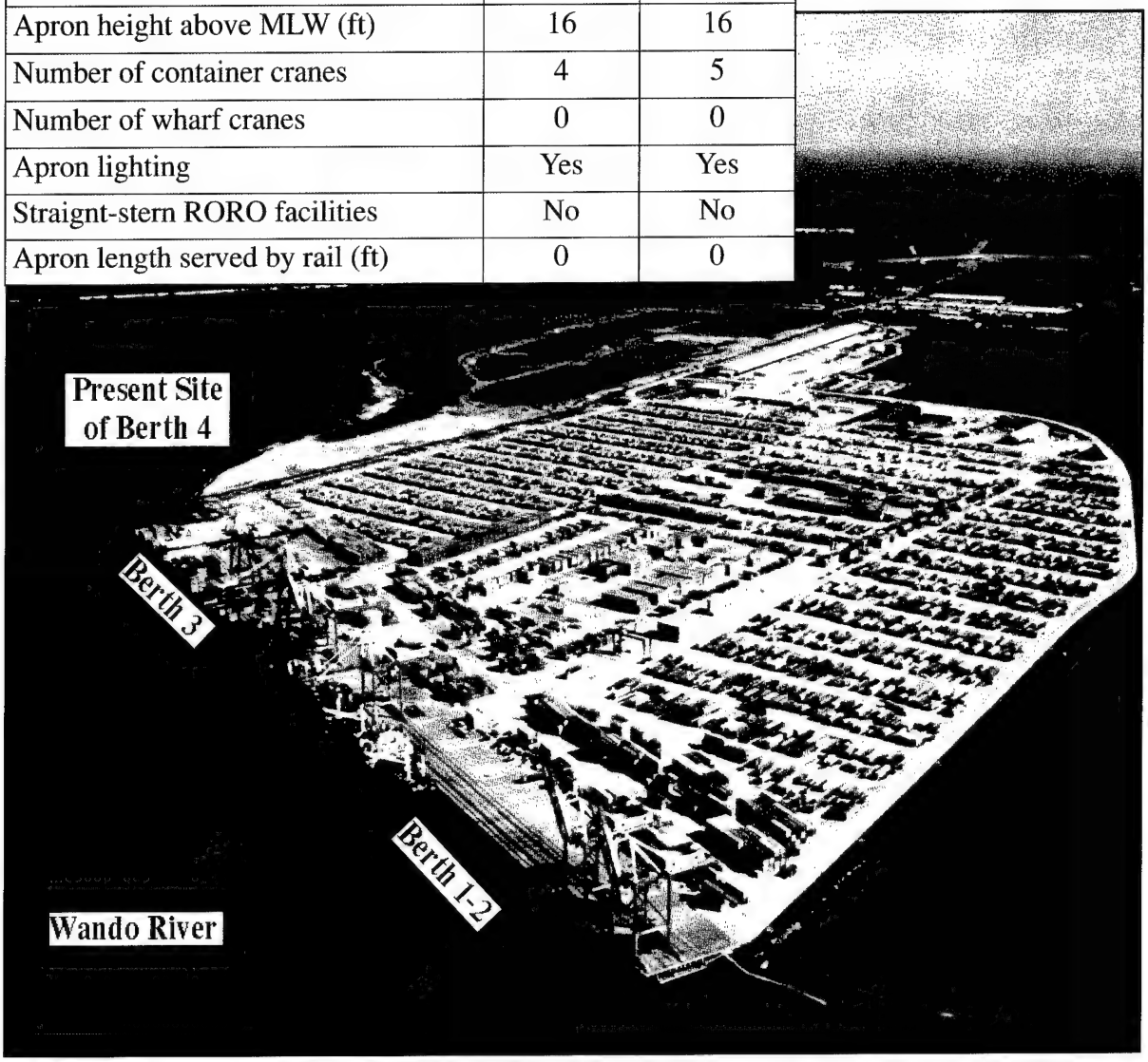


North Charleston Terminal (Westward view)

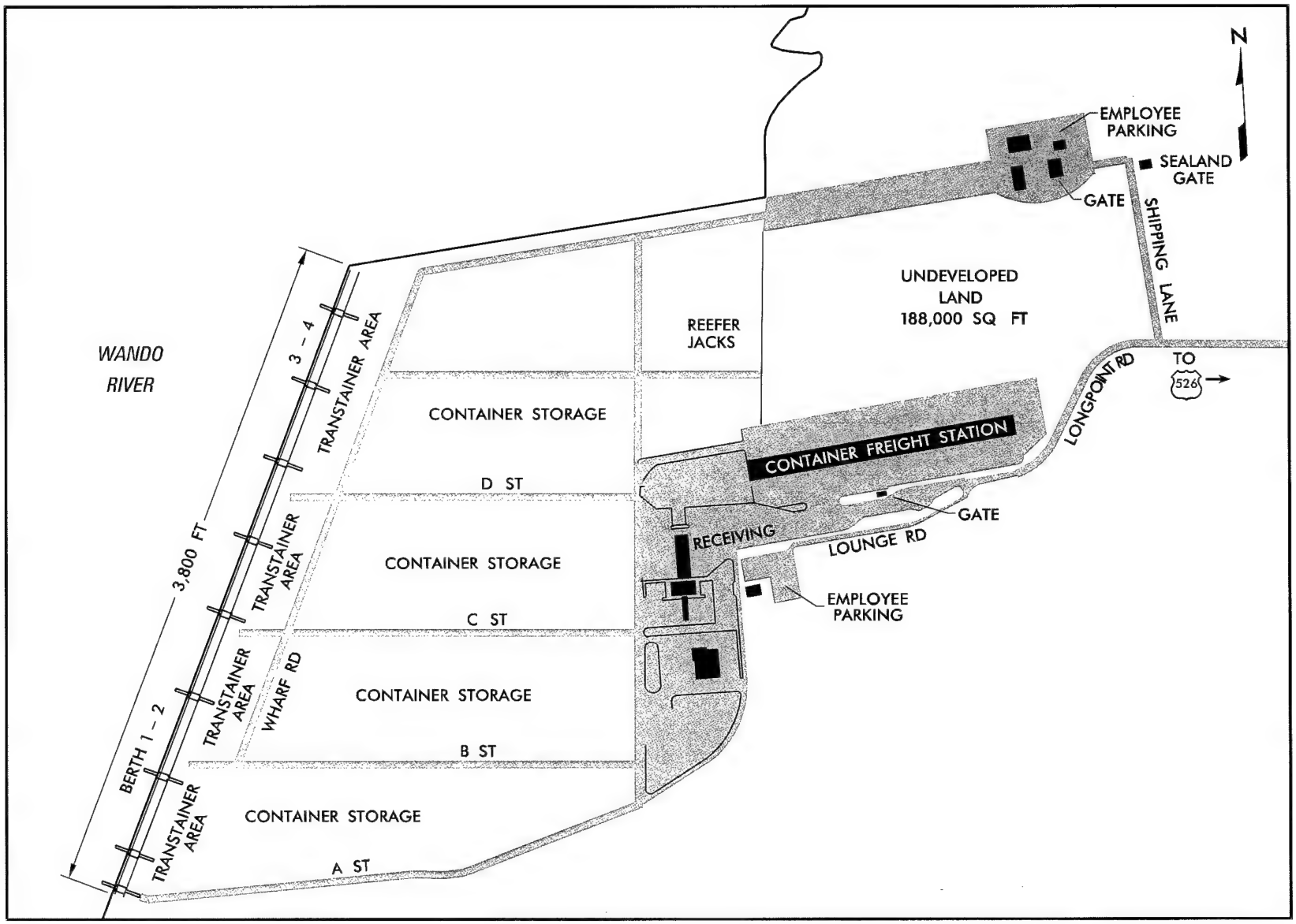


North Charleston Terminal

BERTHING CHARACTERISTICS OF WANDO WELCH TERMINAL		
Characteristics	**Berths**	
	1-2	**3-4**
Length (ft)	1,800	2,000
Depth alongside at MLW (ft)	40	40
Deck strength (psf)	1,000	1,000
Apron width (ft)	Open	Open
Apron height above MLW (ft)	16	16
Number of container cranes	4	5
Number of wharf cranes	0	0
Apron lighting	Yes	Yes
Straignt-stern RORO facilities	No	No
Apron length served by rail (ft)	0	0



Wando Welch Terminal (Eastward view)
(Photo taken before Berth 4 expansion)

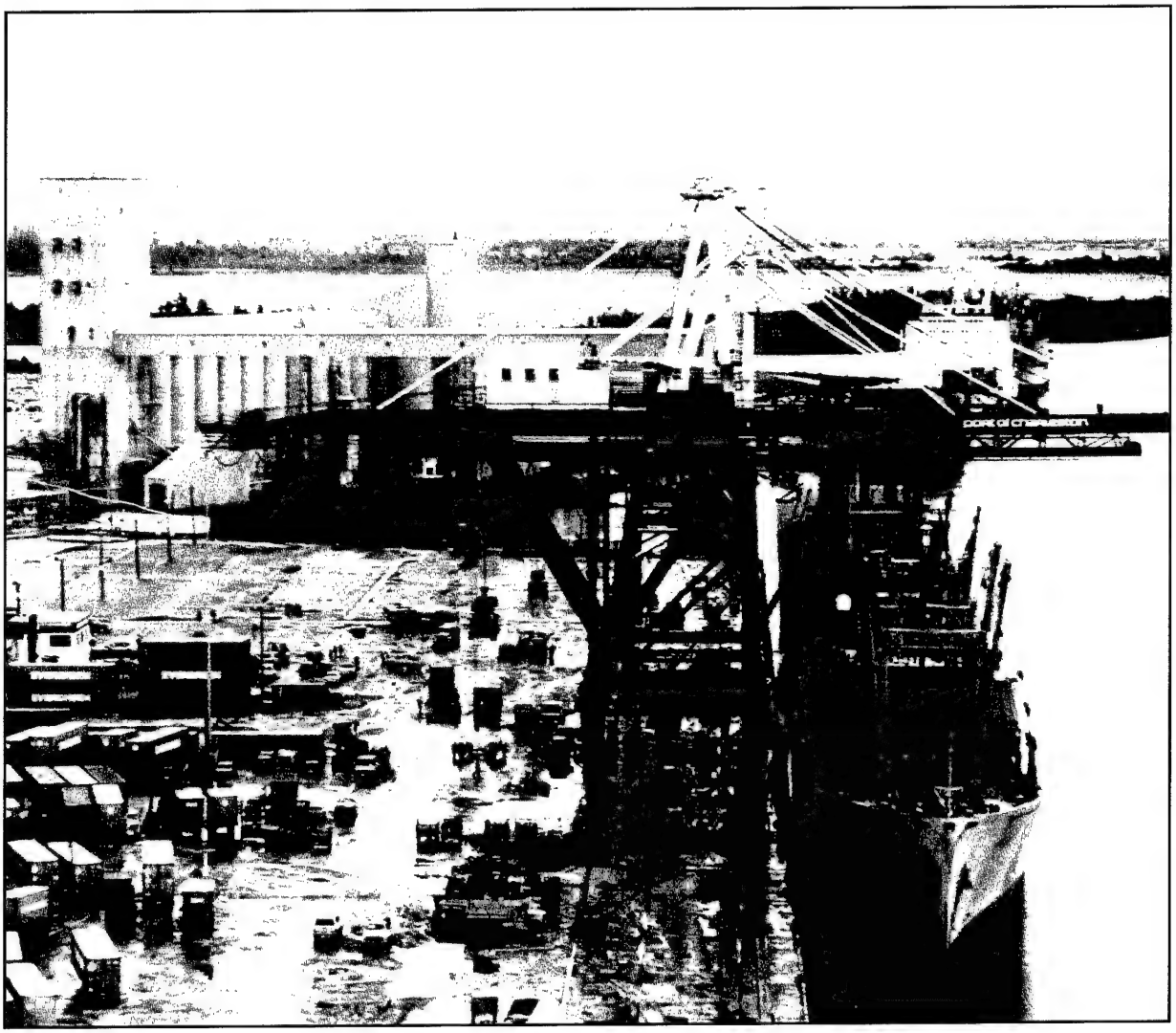


Wando Welch Land-Use Map

Staging

Open Staging. The terminals in this report have a total of 409 acres of paved open staging. Open staging is used for containers and general cargo.

Terminal	Staging Acres
Columbus Street	15
Union Pier	69
North Charleston	130
Wando Welch	195

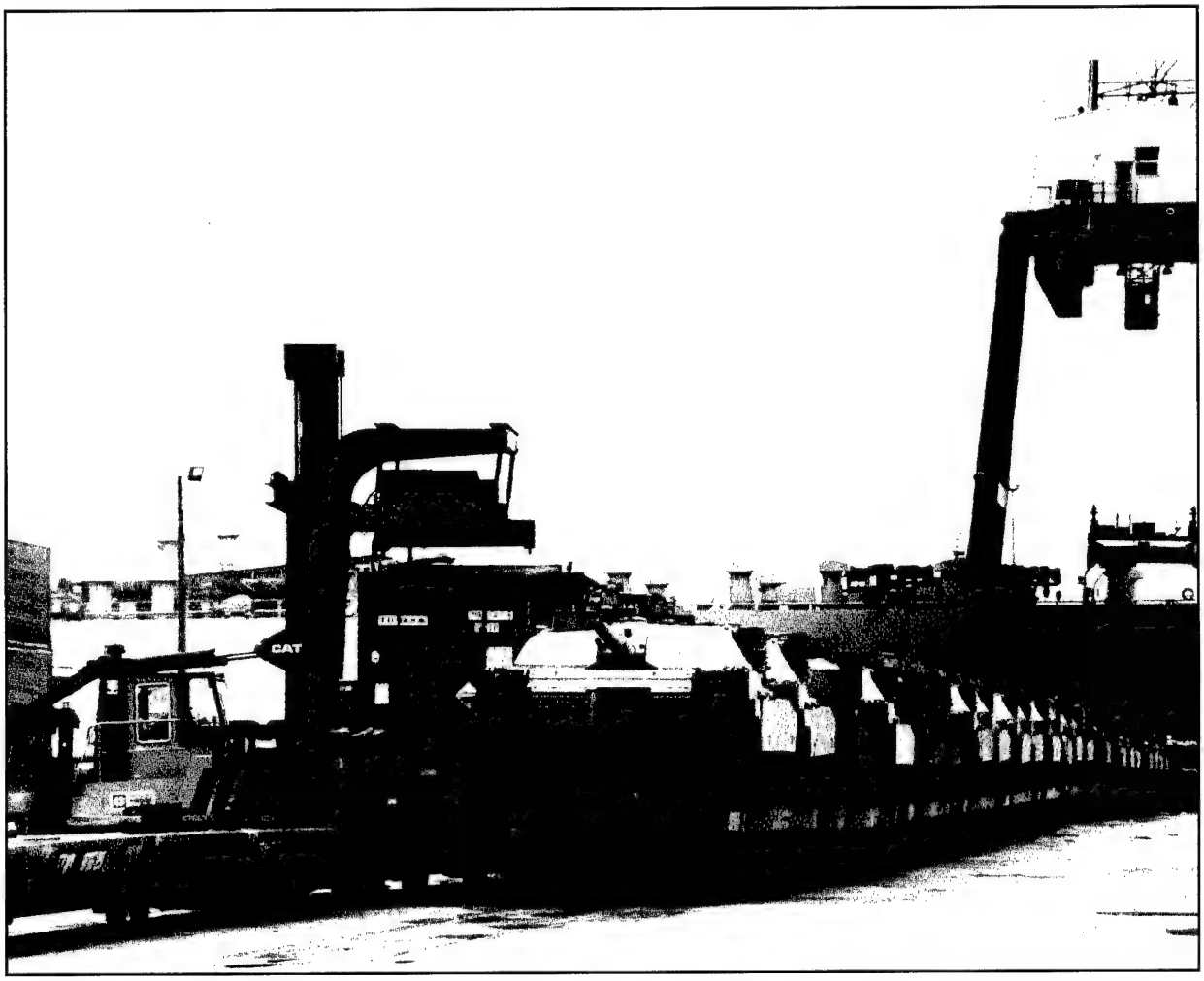


Open Staging at Berth 3 of the North Charleston Terminal (Northeastward view)

Covered Staging. The terminals of this report have about 20 buildings with more than 1-1/2 million square feet of covered storage. Other buildings are set up for manufacturing, passenger, or repair operations, and would not support military operations.

Rail

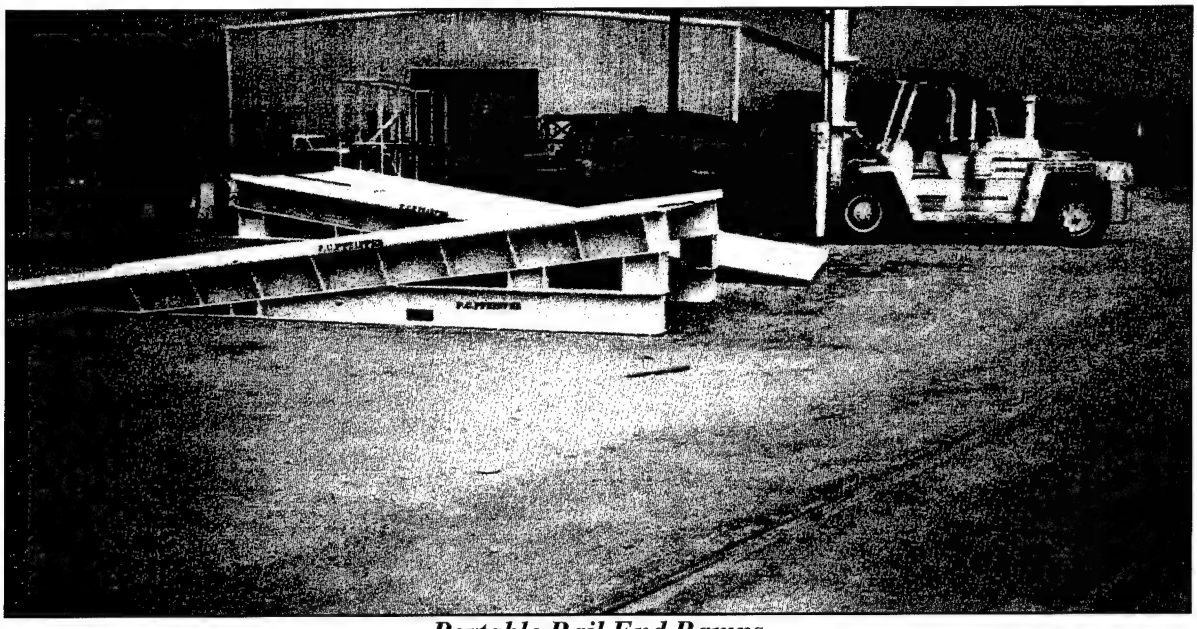
Rail trackage links the railyards to the port's apron tracks, transit sheds, and storage tracks. The South Carolina Public Railway Commission performs switching. Norfolk Southern (NS) and CSX provide rail service. Three major railyards are in the port area and two of them are 2 miles southwest of the North Charleston Terminal.



Abrams Tanks Ready for Offloading
During Desert Storm, at North Charleston Terminal

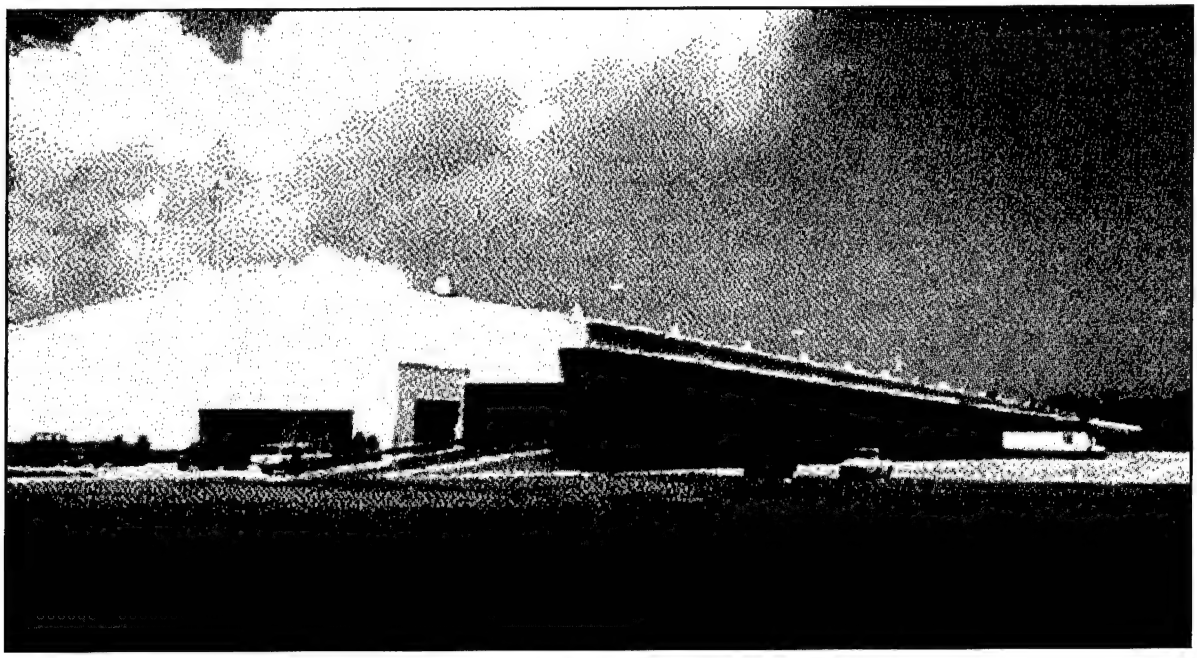
Unloading/loading Positions

Ramps. The only fixed rail end ramp is at the South Atlantic Outport, just north of the North Charleston Terminal. At least two portable rail end ramps are available from local stevedore and rental companies that can be used at any of the terminals. Several locations can support portable end ramp operations.



Portable Rail End Ramps

Docks. Altogether, the terminals have about 385 truck handling positions and 7,900 linear feet of track for boxcar operations.



Truck Docks at Wando Welch Container Freight Station

Marshaling Areas

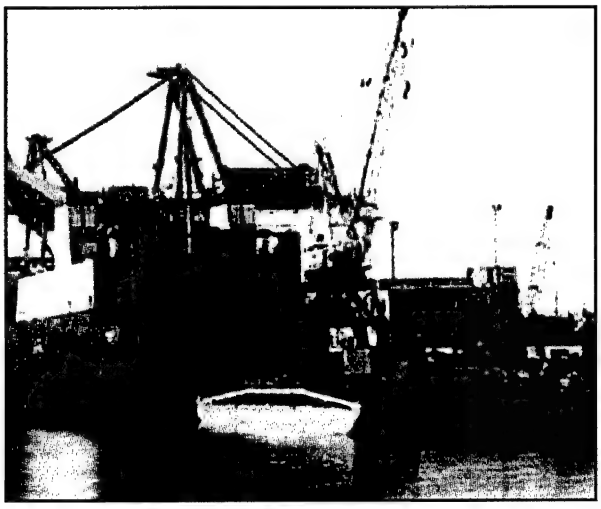
Within port. There are no marshaling areas within the port area. All open area within the port is required for staging military or commercial cargo. Just north of the North Charleston Terminal, however, is the MTMC South Atlantic Outport (SAO). This facility has about 85 acres of open area available for marshaling. The MTMC SAO is often used to support ammunition loading.

Navy Base. Between the Columbus Street and North Charleston Terminals is a closing Navy base with about 1,500 acres that could be used for marshaling. Plans in accordance with President Clinton's policy to revitalize communities include private shipbuilding and repair, other heavy industry, and housing for the homeless. In spite of the overall size of the base, the landfill may be the only open area that will remain available for future marshaling. About 25 acres of grass covered open area can be used to marshal military vehicles.

MATERIAL HANDLING EQUIPMENT (MHE)

The terminals have a total of 18 container cranes. Half of these are at the Wando Welch Terminal. The Union Pier Terminal has no rail-mounted cranes at all. The port owns and operates all the MHE in the chart below.

Although our throughput analysis does not account for the floating RORO ramp, the portable ramp can greatly increase RORO shipping throughput. The ramp can handle vehicles up to 100 tons and can operate at any of the four terminals, with less than a day's notice. The ramp is designed to allow two ships to rapidly load or discharge RORO cargo onto it at the same time, at any tidal condition.



Floating RORO ramp

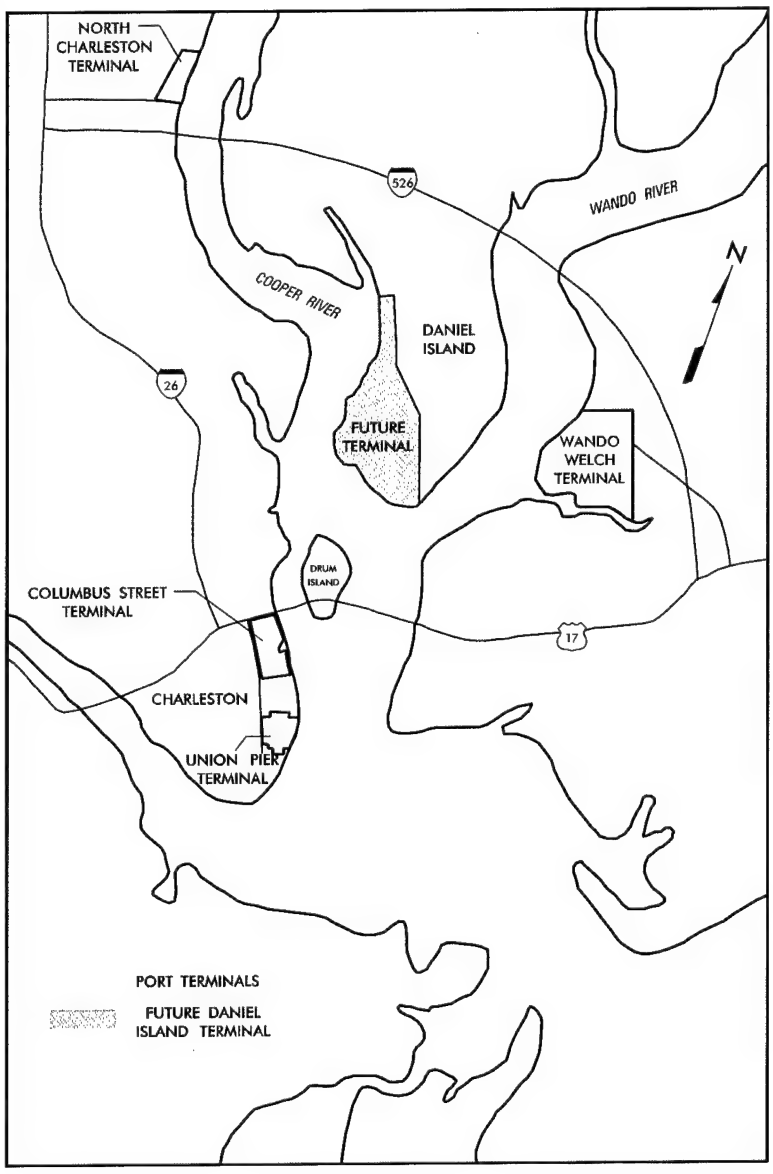
TYPE OF EQUIPMENT	CAPACITY (STONS)	QTY
Container Handlers	40	32
Transtainers	33-44	7
Mobile Cranes	30-150	3
Floating Cranes	67	1
Floating RORO Ramp	100	1

INTERMODAL FACILITIES

The North Charleston Terminal has an onsite intermodal yard with two 1,200-foot spurs. Container handlers regularly offload containers from double stack railcars directly inland of berth 3. Both CSX and NS have intermodal yards in the Charleston area. The Columbus Street Terminal also has an intermodal area, approximately 1,200 linear feet, that is now regularly handling containers to and from double stack railcars.

FUTURE DEVELOPMENT

The port hopes to develop 800 acres of land on the southwest section of Daniel Island. This island, between Wando Welch and North Charleston Terminals, will be developed in phases. Eventually, the port expects CSX and/or NS to provide double stack service to the new container facility. Trucks will have easy access to I-526.

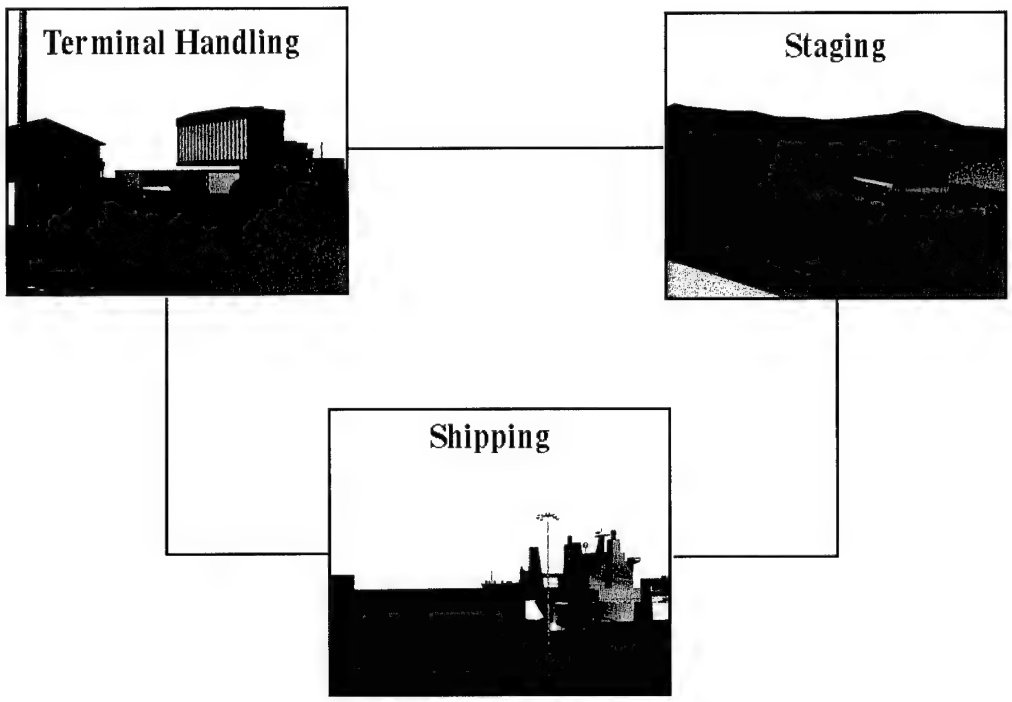


Future Daniel Island Terminal

II. THROUGHPUT ANALYSIS

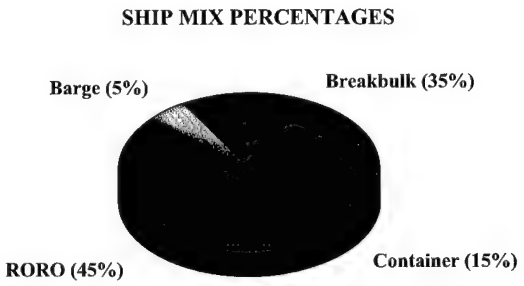
GENERAL

This section evaluates the throughput capability of the Port of Charleston using the port operational performance simulator (POPS) computer model. The model is based on a weak- link analysis in which each subsystem is analyzed separately and then compared to find the least capable subsystem. The weakest subsystem defines the maximum throughput capability of the terminal. The model yields throughput capability values for three subsystems - shipping, staging, and terminal processing/handling - in terms of measurement tons (MTON) per day.



Terminal Throughput Subsystems

This analysis assumes a maximum of 80 percent of the port facilities can be made available at any one time. For this reason, we ran all port analyses using an 80 percent facility-use factor. Also, the ship mix is based on Desert Shield and Desert Storm statistics. We weighted the percentages to adjust for differences in cargo deadweights and expectations for future deployments.



TERMINAL RECEPTION/HANDLING

Highway

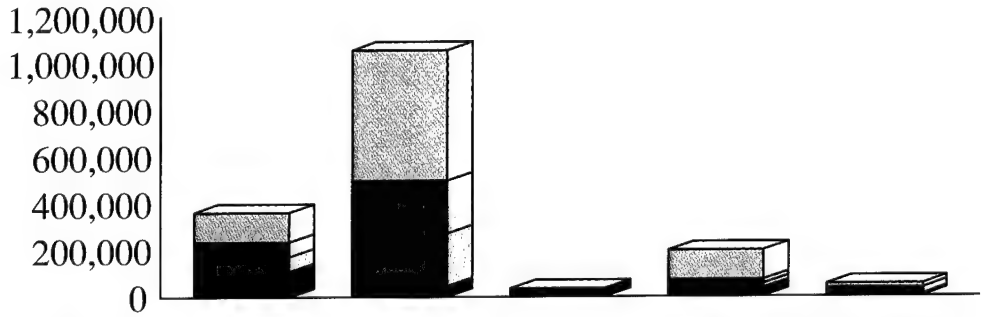
I-26 and -526 provide access to the port terminals. Each terminal has a designated entrance for trucks. The road network in and out of the terminals, including the gate processing of vehicles, could handle about 290,000 MTON of equipment and supplies per day.

Roadable vehicles in convoys will process directly to the staging areas. Vehicles on commercial or military flatbed trailers without integral ramps will offload at portable ramps. There are no permanent truck end ramps at any of the terminals. Our analysis assumes the port can acquire or build two portable or temporary truck ramps at each of the four terminals. These ramps could offload more than 38,000 MTON from flatbed trailers per day.

Supplies in van semitrailers will proceed to roughly 220 van-handling positions. These docks can offload more than 198,000 MTON of van semitrailer-shipped materials per day. This report assumes there are 10 rented container handlers for chassis operations that can offload about 53,000 MTON of chassis cargo per day.

HIGHWAY RECEPTION / HANDLING CAPABILITY

MTON / DAY



SUBSYSTEMS	HIGHWAY	GATES	END-RAMPS*	DOCKS	CONTAINERS**
COLUMBUS STREET	110,000	45,000	9,600	38,000	11,000
UNION PIER	57,000	230,000	9,600	19,000	0
NORTH CHARLESTON	73,000	230,000	9,600	13,000	20,000
WANDO WELCH	120,000	550,000	9,600	128,000	22,000

*8 portable or temporary ramps are assumed available.

**10 container handlers are assumed available.

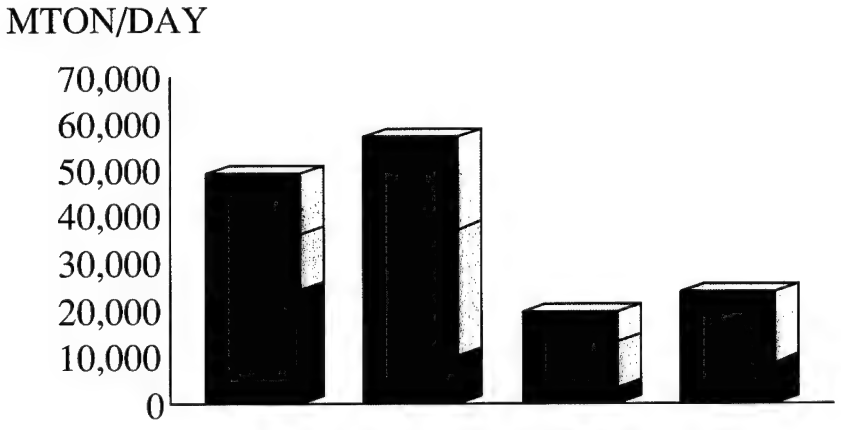
Rail

Rail reception at the port is good with two major railroad companies accessing Charleston. The North Charleston Terminal has the best rail facilities. There are no tracks accessing the Wando Welch Terminal. This analysis assumes the port can rent, build, or provide six portable or temporary rail end ramps. These would be placed at tangential tracks 500 to 1,500 feet long. Columbus Street Terminal could support a 1,500-foot track at the inland railyard or along the apron.

Terminal	Train Length (railcars)	Trains Per Day
Columbus Street	60	4
Union Pier	60	2
North Charleston	60	2
Wando Welch	-	-

Boxcars could offload at the transit sheds where about 135 boxcar handling positions are available.

RAIL RECEPTION/HANDLING CAPABILITY



SUBSYSTEMS	TRACKAGE	END-RAMPS*	DOCKS	COFC**
COLUMBUS STREET	24,000	10,000	3,300	8,700
UNION PIER	12,000	27,000	9,800	0
NORTH CHARLESTON	13,000	20,000	6,500	15,000
WANDO WELCH	0	0	0	0

*6 portable or temporary ramps are assumed available.

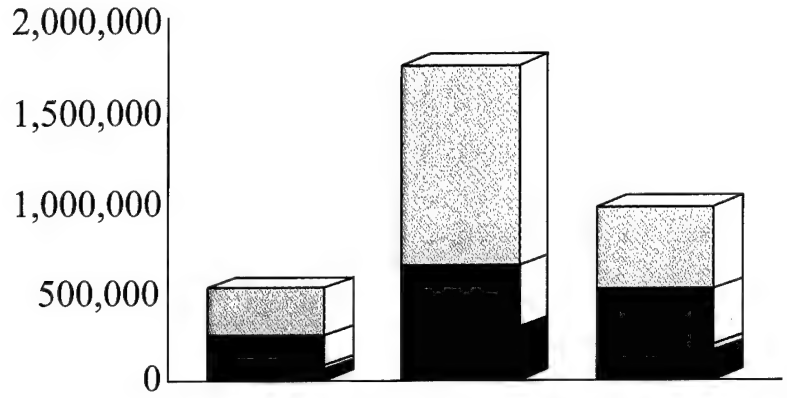
**6 container handlers are assumed available.

STAGING

The terminals of this report have a total of about 400 acres of open paved staging. There is also more than 1-1/2 million square feet of covered storage.

OPEN STAGING CAPABILITY

MTON/DAY



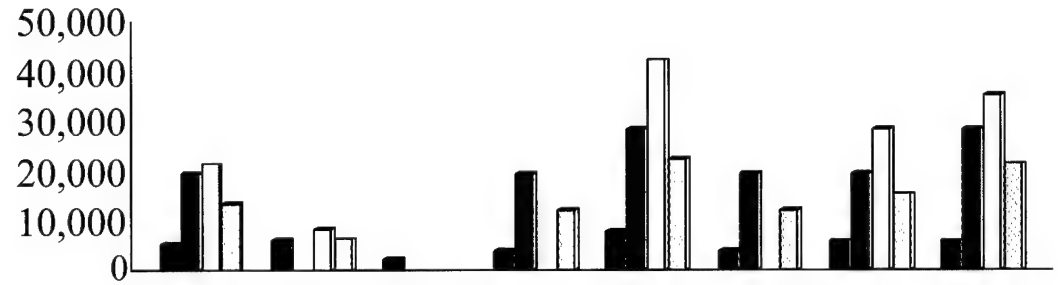
VESSEL TYPE	RORO	CONTAINERS	BREAKBULK
COLUMBUS STREET	64,000	290,000	160,000
UNION PIER	19,000	0	37,000
NORTH CHARLESTON	170,000	350,000	310,000
WANDO WELCH	260,000	1,100,000	460,000

SHIPPING

Throughputs for each berth are shown below. They are based on various factors, including MHE used, loading, operational, and berth usage rates, as well as berth/ship compatibility.

BERTH THROUGHPUT CAPABILITY

MTON/DAY



BERTH	C1-2	C3-4	U1-2	U3-4	N1-3	MTMC	W1-2	W3-4
BREAKBULK	4,900	5,900	1,900	3,800	7,500	3,800	5,600	5,600
RORO	19,000	0	0	19,000	28,000	19,000	19,000	28,000
CONTAINER	21,000	8,000	0	0	42,000	0	28,000	35,000
MIXED	13,000	6,100	0	12,000	22,000	12,000	15,000	21,000

C = Columbus Street U = Union Pier
N = North Charleston W = Wando Welch

CONVERSION FACTORS	
Breakbulk	.4 STON per MTON
RORO	.25 STON per MTON
Containers	.4 STON per MTON

The type of ship preferred at each berth is based on the methodology described in Appendix B. The evaluation is based on a snapshot view of the current physical characteristics of the berths and the MHE available. The evaluation to the right gives no considerations for enhancements, such as equipment. The floating RORO ramp was not considered. If it is available for military operations, it would greatly improve RORO loading at any of the berths. The lower the number for a berth, the better the berth is suitable for the loading operation.

The Wando Welch berths are well suited for loading any type of ship. They are highly rated on the chart because of the cranes, container freight station, and age. However, when rail access is considered, the Columbus Street Terminal berth 1-2 is the best choice for military operations. Furthermore, the Wando Welch aprons are 16 feet above MLW. This prevents fully RORO loading an FSS with dense cargo (such as ammunition) at low tide.

FSS operations are recommended at Columbus Street Terminal berth 1-2, Union Pier Terminal berth 3-4, North Charleston Terminal berth 1-3, and any Wando Welch berth. Because of their stern ramps, we believe LMSRs will be able to load at any Port of Charleston berth in this report except Union Pier Terminal berth 1-2. The buildings and weak pavement of this berth restrict all RORO loading.

PREFERENCE BERTH SELECTION

Berth	BB	RORO	CNTNR
Columbus Street			
1-2	3	1	4
3-5	4	-	5
Union Pier			
1-2	7	-	-
3-4	6	5	-
North Charleston			
1-3	5	5	1
MTMC	8	4	-
Wando Welch			
1-2	2	2	3
3-4	1	2	2

SUMMARY OF BERTHING CAPABILITIES OF COLUMBUS STREET AND UNION PIER TERMINALS

Vessel	Berths C = Columbus Street		U = Union Pier	
	C1-2	C3-5	U1-2	U3-4
Breakbulk				
C3-S-33a	3	3	1	2
C3-S-37c2	3	3	1	2
C3-S-37d	3	3	1	2
C3-S-38a	3	3	1	2
C4-S-1a	2	3	1	2
C4-S-1qb and 1u	2	3	1	2
C4-S-58a	2	3	1	2
C4-S-65a	2	3	1	2
C4-S-66a	2	3	1	2
C4-S-69b	2	3	1	2
Seatrain				
GA and PR-class	2	3	1	2
Barge				
LASH C8-S-81b	1	2	1	1
LASH C9-S-81d	1	2	1	1
LASH lighter	11	14	7	10
SEABEE C8-S-82a	1	2	1	1
SEABEE barge	8	10	5	7
RORO				
Comet	d,i,j	d,o	d,o	d,i,j
C7-S-95a/Maine-class	2	b	b	1
Ponce-class	h	b,h	b,h	h
Great Land-class	h	b,h	b,h	h
Cygnus/Pilot-class	2	b	b	2
Meteor	d,i,j	d,o	d,o	j,i,j
AmEagle/Condor	i,j	b	b	i,j
MV Ambassador	d	d	d	d
FSS-class	1	b	b	1
Cape D-class	i,j	b	b	i,j
Cape H-class	2	b	b	1
LMSR	1	b	b	1
Container				
C6-S-1w	2	2,e	1,e	2,c
C7-S-68e	2	2,e	1,e	2,e
C8-S-85c	1	2,e	1,e	1,e
Combination				
C5-S-78a	2	3,e	1,e	2,e
C5-S-37e	2	3,e	1,e	2,e

a=vessel draft limited to berth depth
b=inadequate apron width
c=inadequate berth length
d=no straight stern-ramp facilities
e=no container-handling equipment
f=shallow berth, adequate anchorage depth
g=inadequate channel depth
h=no shore-based ramps available
i=insufficient ramp clearance at low tide
j=insufficient ramp clearance at high tide
k=excessive ramp angle at low tide
m=excessive ramp angle at high tide
n=parallel ramp operation only
o=too narrow apron for side-ramp

Notes: Ramp clearance and ramp angle based on maximum vessel draft
( ) indicates vessels assigned by analyst

SUMMARY OF BERTHING CAPABILITIES OF NORTH CHARLESTON AND WANDO WELCH TERMINALS

Vessel	Berths N = North Charleston		W = Wando Welch	
	N1-3	N-MTMC	W1-2	W3-4
Breakbulk				
C3-S-33a	4	2	3	3
C3-S-37c2	4	2	3	3
C3-S-37d	4	2	3	3
C3-S-38a	4	2	3	3
C4-S-1a	4	2	3	3
C4-S-1qb and 1u	4	2	3	3
C4-S-58a	4	2	3	3
C4-S-65a	4	2	3	3
C4-S-66a	4	2	3	3
C4-S-69b	4	2	3	3
Seatrain				
GA and PR-class	4	4	2	3
Barge				
LASH C8-S-81b	2	1	2	2
LASH C9-S-81d	2	1	1	2
LASH lighter	17	10	12	14
SEABEE C8-S-82a	2	1	1	2
SEABEE barge	12	7	8	10
RORO				
Comet	d,i,j	d,i,j	d,i,j	d,i,j
C7-S-95a/Maine-class	3	1	2,i	2i
Ponce-class	h	h	h	h
Great Land-class	h	h	h	h
Cygnus/Pilot-class	3	2	2,i	3,i
Meteor	d,i,j	d,i,j	d,i,j	d,i,j
AmEagle/Condor	i,j	i,j	i,j	i,j
MV Ambassador	d	d	d	d
FSS-class	2	1,n	1,i	2,i
Cape D-class	i,j	i,j	i,j	i,j
Cape H-class	2	1	2,i	2,i
LMSR	2	1,n	1,i	2,i
Container				
C6-S-lw	3	2,e	2	2
C7-S-68e	3	2,e	2	2
C8-S-85c	2	1,e	1	2
Combination				
C5-S-78a	3	2,e	2	3
C5-S-37e	3	2,e	2	3

a=vessel draft limited to berth depth
b=inadequate apron width
c=inadequate berth length
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e=no container-handling equipment
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h=no shore-based ramps available
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j=insufficient ramp clearance at high tide
k=excessive ramp angle at low tide
m=excessive ramp angle at high tide
n=parallel ramp operation only
o=too narrow apron for side-ramp

Notes: Ramp clearance and ramp angle based on maximum vessel draft
( ) indicates vessels assigned by analyst

III. APPLICATION

GENERAL

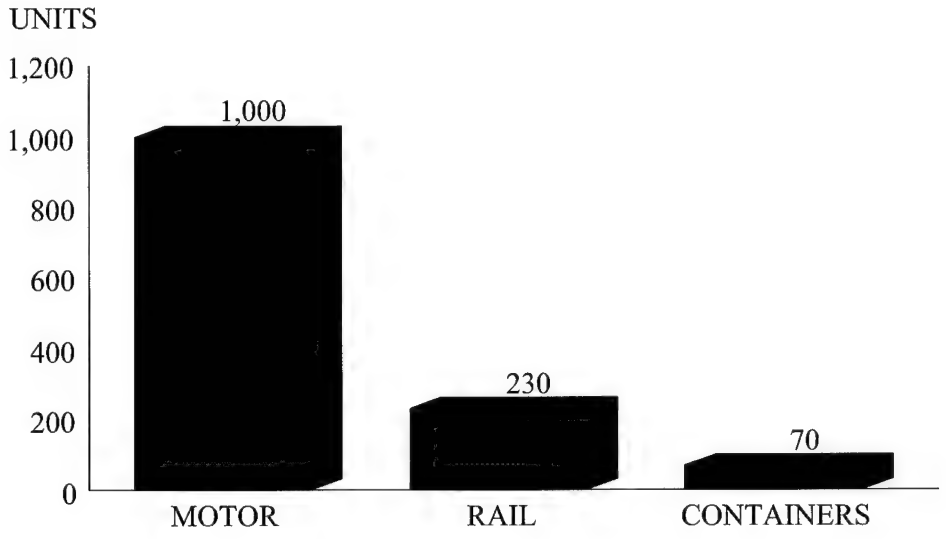
This section of the report will evaluate the port's throughput capability for deploying elements of the XVIIIth Airborne Corps, Corps Support Command from Fort Bragg, North Carolina using primarily FSS vessels, in 6 days of reception and handling. The August 1994 revision for the ***Planning Orders Digest***, issued by MARAD, provided agreements for military use of the Port of Charleston. These agreements have been renewed until 15 June 1996. The Planning Orders call for the use of the following facilities at the North Charleston Terminal: 20 acres open staging and berths 1, 2, and 3 (total 2,430 feet of berthing). The South Atlantic Outport (SAO) is adjacent to the North Charleston Terminal.

REQUIREMENTS

Units making up this "Corps Slice" of the XVIIIth Airborne Corps remain unidentified. For this analysis, we assume the unit will require 6,000 vehicles by convoy (1,000 per day), 1,380 railcars (230 per day), and 420 containers (70 per day).

Three FSS-sized vessels will load simultaneously. Each sustained loading operation will conduct three shiploading cycles, for a total of nine FSS-sized shiploads.

DAILY REQUIREMENTS



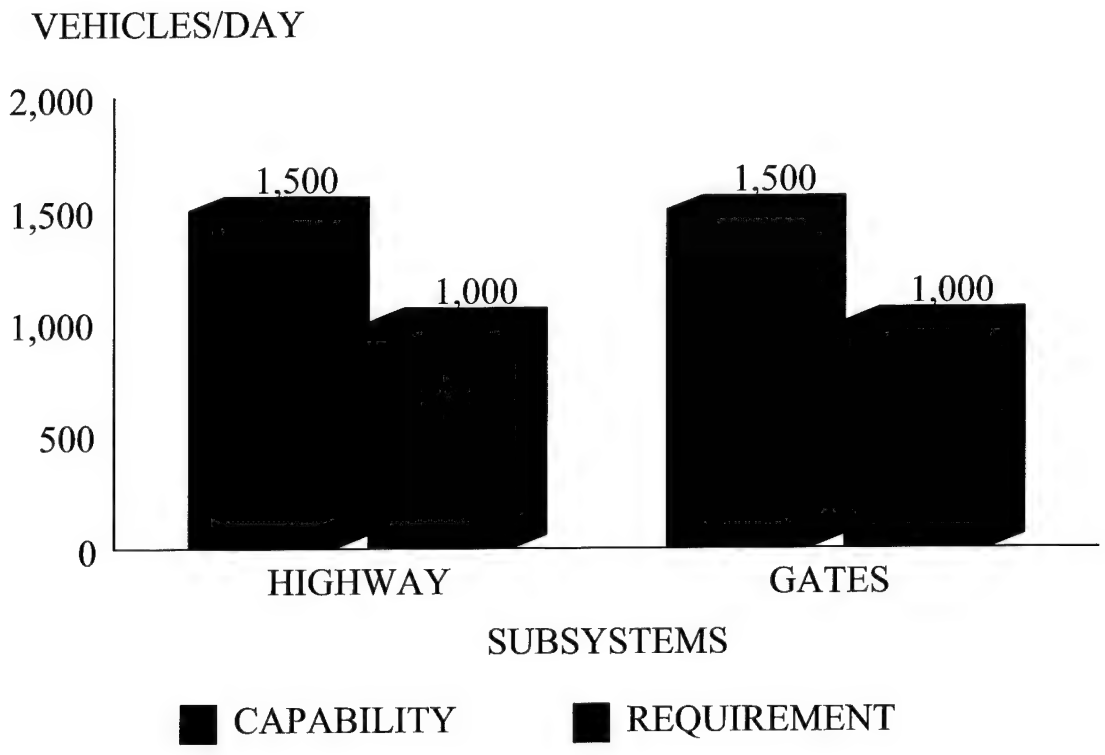
TERMINAL INPROCESSING/HANDLING

Highway

Terminal operators at the North Charleston Terminal should open either of the two gates on Remount Road, directly accessible from Interstate Routes 26 and 526. Depending on the available staging at the time of deployment, convoys would enter the SAO gate or the North Charleston Terminal gate. An exclusive gate between the two areas allows vehicles to traverse from one facility to the other. Remount Road and these two gates can easily handle 1,500 vehicles per day without causing significant delays in traffic. This meets the 1,000 vehicle per day requirement..

As convoys arrive, support personnel account for the vehicles and send them to staging areas or directly to shipside for loading. They direct non-roadable equipment arriving by commercial or military truck or on flatbed trailer to the container stuffing station for unloading and subsequent staging.

HIGHWAY INPROCESSING CAPABILITY



Rail

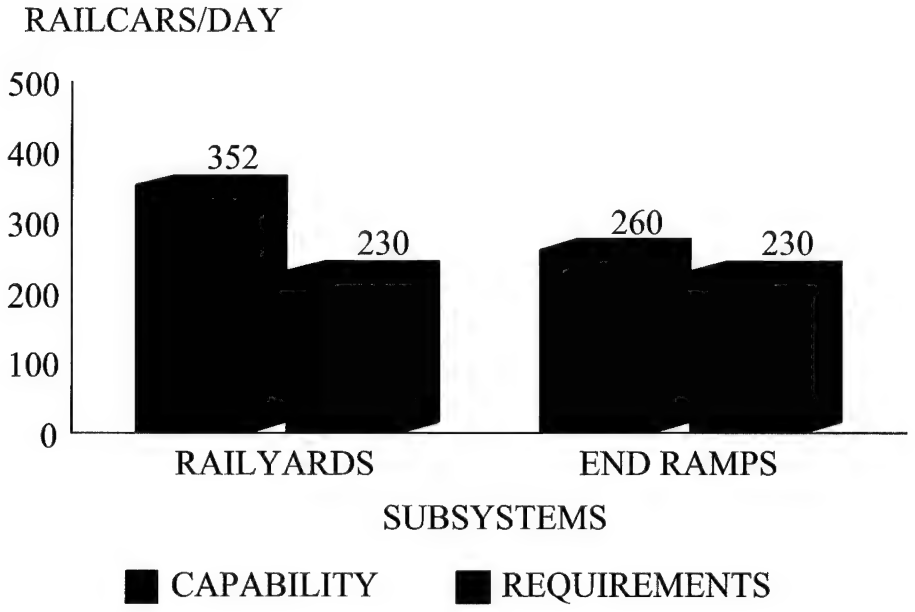
Two major railroads serve the North Charleston Terminal, the Norfolk Southern and the CSX. The North Charleston Terminal can accommodate and unload more than 50 each, 89-foot railcars per cycle. The terminal's general manager states that they can unload four blocks of cars daily. for a total of 200+ cars per day. The SAO's tracks can hold 76, 89-foot railcars. The railroads normally spot a block of cars at the outport at night for working the next day. Providing adequate support by the railroads, the outport can unload at least two blocks of cars or 152 cars per day.

SAO unloads railcars at two ramp positions. The first is located at the foot of "A" track, which is about 2,700 feet long. The second is a ramp on "F" track, which is about 1,800 feet long.

The North Charleston Terminal uses two heavy duty portable ramps rated at 90-tons for unloading wheeled vehicles and tracks from railcars. The terminal places these ramps wherever they choose to do rail offload operations. The two spurs in the open area near berth 3 are each about 1,000 feet long.

Assuming four cycles at each ramp per day, the North Charleston Terminal and SAO together can support offloading about 260 railcars per day.

RAIL INPROCESSING AND HANDLING CAPABILITY



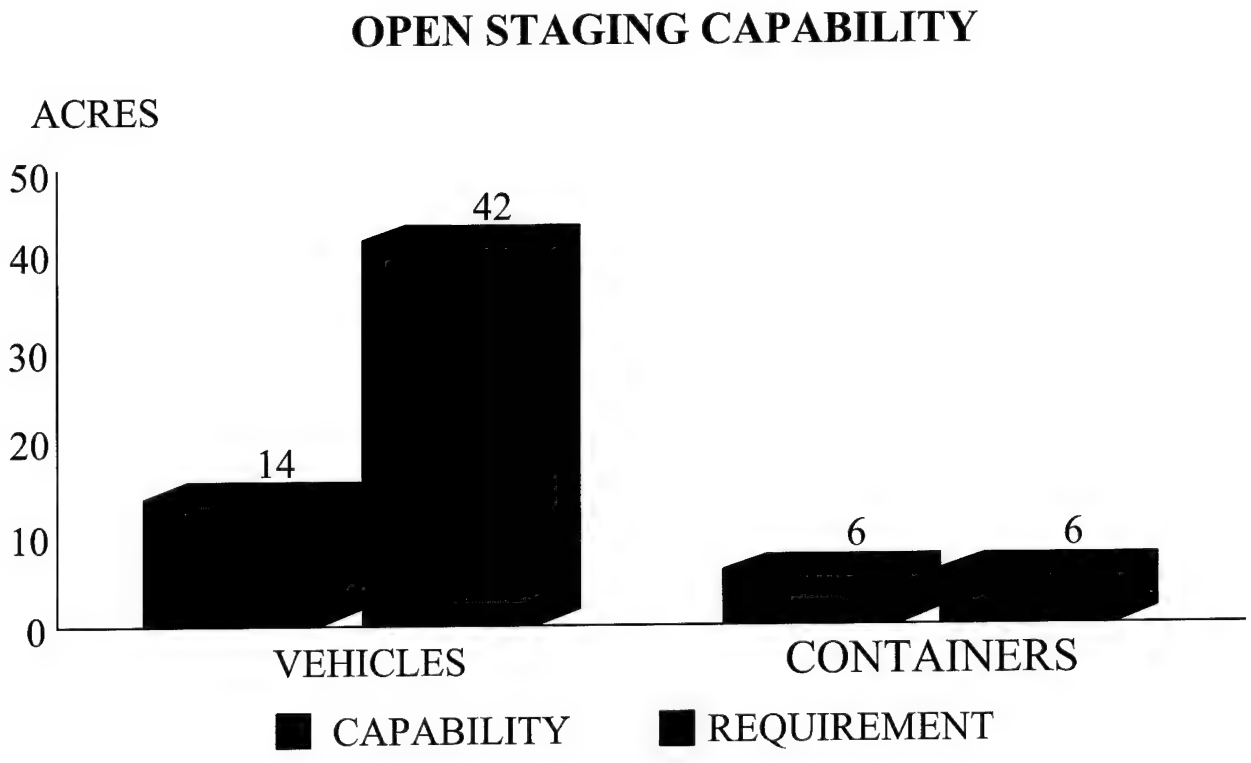
STAGING

This analysis assumes that nine FSS-sized ships will deploy the unit. Three ships will depart every 2 days. Because of this, the staging requirement is to support three sustained loading operations.

Although an FSS-load of cargo can be staged and loaded on 10 acres, 16 acres are required for sustained loading operations. Of these 16 acres, about 2 acres are required for the staging of the 46 containers for each FSS. The three simultaneous ship loading operations will require 48 acres of open staging, of which about 6 acres are dedicated to containers.

The North Charleston Terminal has approximately 185 acres of open staging area. This space is normally used to store/stage containers. About 30% of this area (about 55 acres) is likely to be immediately available to support military deployments.

The South Atlantic Outport (SAO) has more than 85 acres of open area that can be used for staging equipment. We expect the availability of most of SAO's staging area. The staging area at the North Charleston Terminal and the SAO total 140 acres. This exceeds the 48 acres needed to support three FSS/LMSR vessel operations. However, the 20 acres provided in the Planning Orders do not meet the requirements.

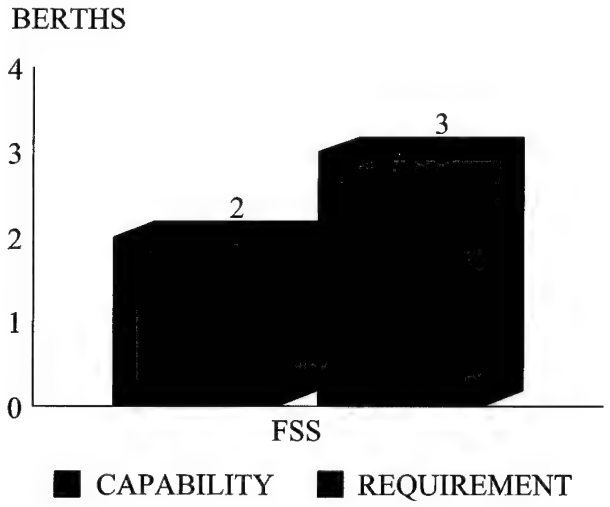


SHIPPING

Although this analysis assumes that nine FSS-sized ships can deploy the unit, the number of ships required depends on the shipping mix selected. The best ship mix would consist of all eight FSS ships, plus one Cape H RORO ship.

The requirement is to work three FSS- or LMSR-sized ships concurrently. Berths 1-3 at the North Charleston Terminal can accommodate two of these ships and the SAO can accommodate one. Together the two facilities can fully support the requirement. However, the 2,430 feet of apron provided in the Planning Orders do not meet the requirement.

FSS SHIPPING CAPABILITY



SUMMARY

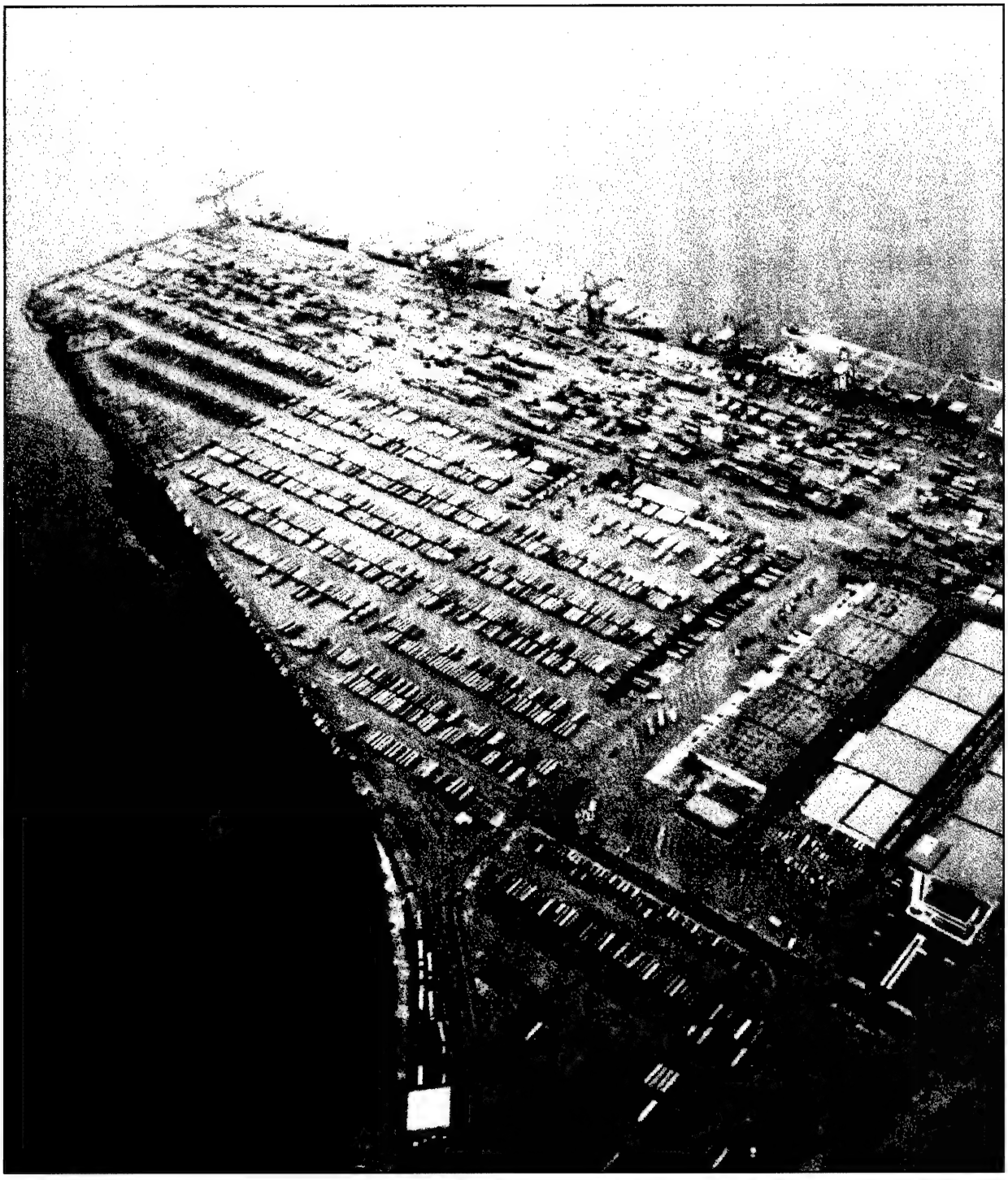
The combination of the North Charleston Terminal and the South Atlantic Outport has adequate characteristics to support the deployment of the units. The Planning Orders alone are insufficient.

RECOMMENDATION

In addition to the facilities provided in the Planning Orders, we recommend the military negotiate for the following facilities:

- Berthing for an additional FSS sized vessel
- Staging area of an additional 28 acres
- 5,800 feet of tangential track for rail offloading operations
- 2 to 4 rail end ramps depending on number of spurs

PORT OF HAMPTON ROADS, VA

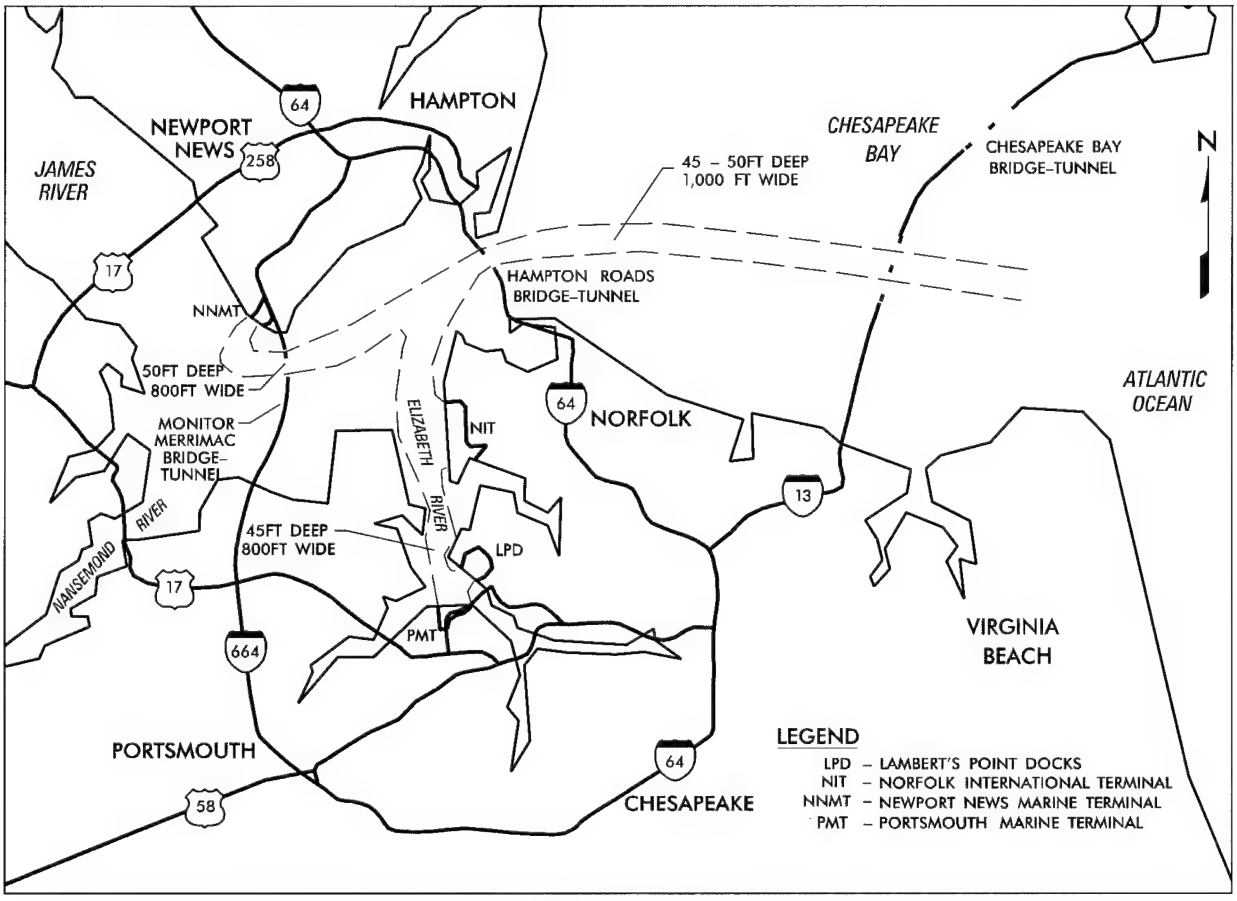


I. GENERAL DATA

TRANSPORTATION ACCESS

Water

Entry to the deep waters of Hampton Roads is between the Virginia Capes at the lower end of the Chesapeake Bay. The Thimble Shoal entry channel is 50 feet deep by 1,000 feet wide. From Hampton Roads, the 19.6-mile-long southward channel leads to Norfolk International Terminal (NIT), Lambert's Point Docks (LPD), and Portsmouth Marine Terminal (PMT). The southward channel is 50 feet deep by 1,500 feet wide to just south of NIT, where it reduces to 800 feet wide. The 4.8-mile-long northward channel leads to the Newport News Marine Terminal (NNMT). The Newport News Channel is 800 feet wide by 50 feet deep. The mean tides range from 2.5 to 2.8 feet.

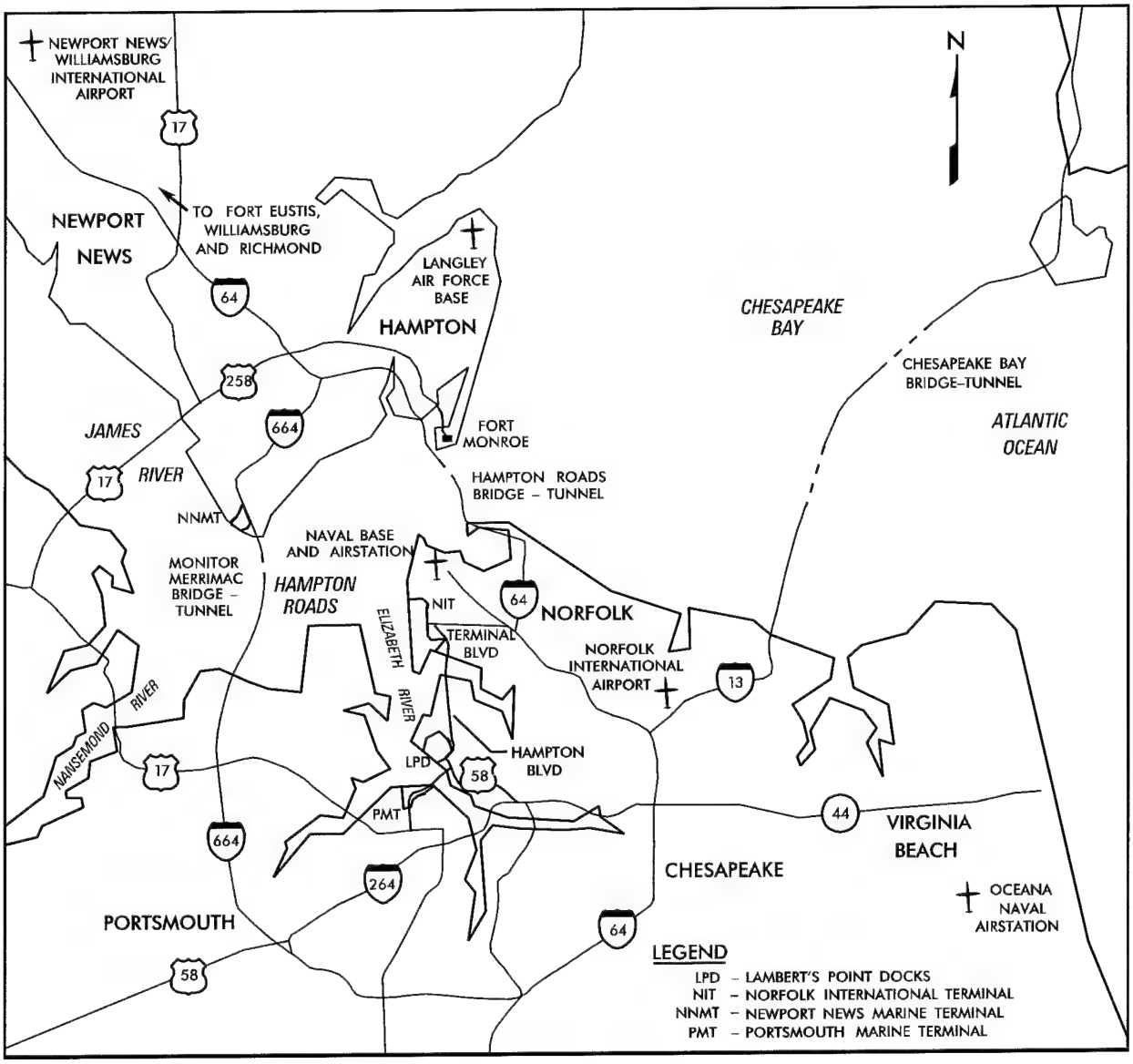


Water Access

Highway

Interstate Routes 64 and 664 (I-64/-664) serve the Hampton Roads terminals. NNMT has direct access to I-664. NIT connects to Terminal Boulevard, which provides direct access to I-64. From NIT to I-64 is less than 5 miles. LPD accesses two local streets, Orapax Street and Raliegh Avenue, to reach Hampton Boulevard, a four-lane road. Hampton Boulevard provides access to Terminal Boulevard to the north or State Route 58 to the south. Traffic follows State Route 58 to Interstate 264 (I-264).

PMT traffic accesses State Route 58 to reach I-264. I-264 provides access to I-664 to the west and I-64 to the east.



Highway Access

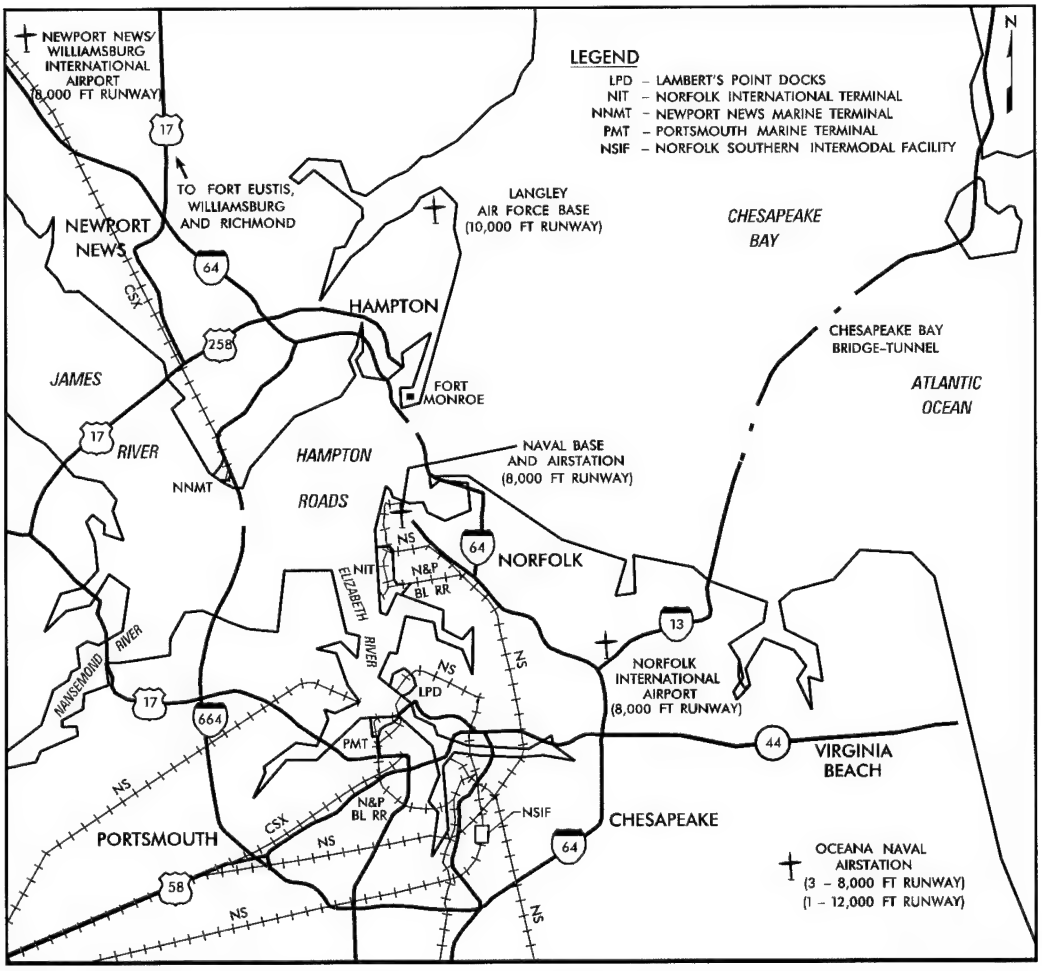
Rail

Three companies comprise the Hampton Roads rail network: Norfolk Southern Corporation (NS), CSX Transportation Inc. (CSX), and the Norfolk and Portsmouth Belt Line Railroad (N&P BL RR). Shipside rail service is available at all four terminals.

CSX provides rail service to NNMT. No interconnecting railway exists between NNMT and the other three terminals. NIT rail access consists of a direct connection with the Norfolk Southern Corporation. CSX serves NIT via the N&P BL RR. NS provides rail service to LPD. PMT rail access consists of a direct connection with CSX and service by NS via the N&P BL RR.

Airports

Newport News/Williamsburg International Airport and Langley Air Force Base are the air receiving sites for NNMT. Norfolk International Airport and Norfolk Naval Air Station support NIT, LPD, and PMT.



Rail and Air Access

PORT FACILITIES

Berthing

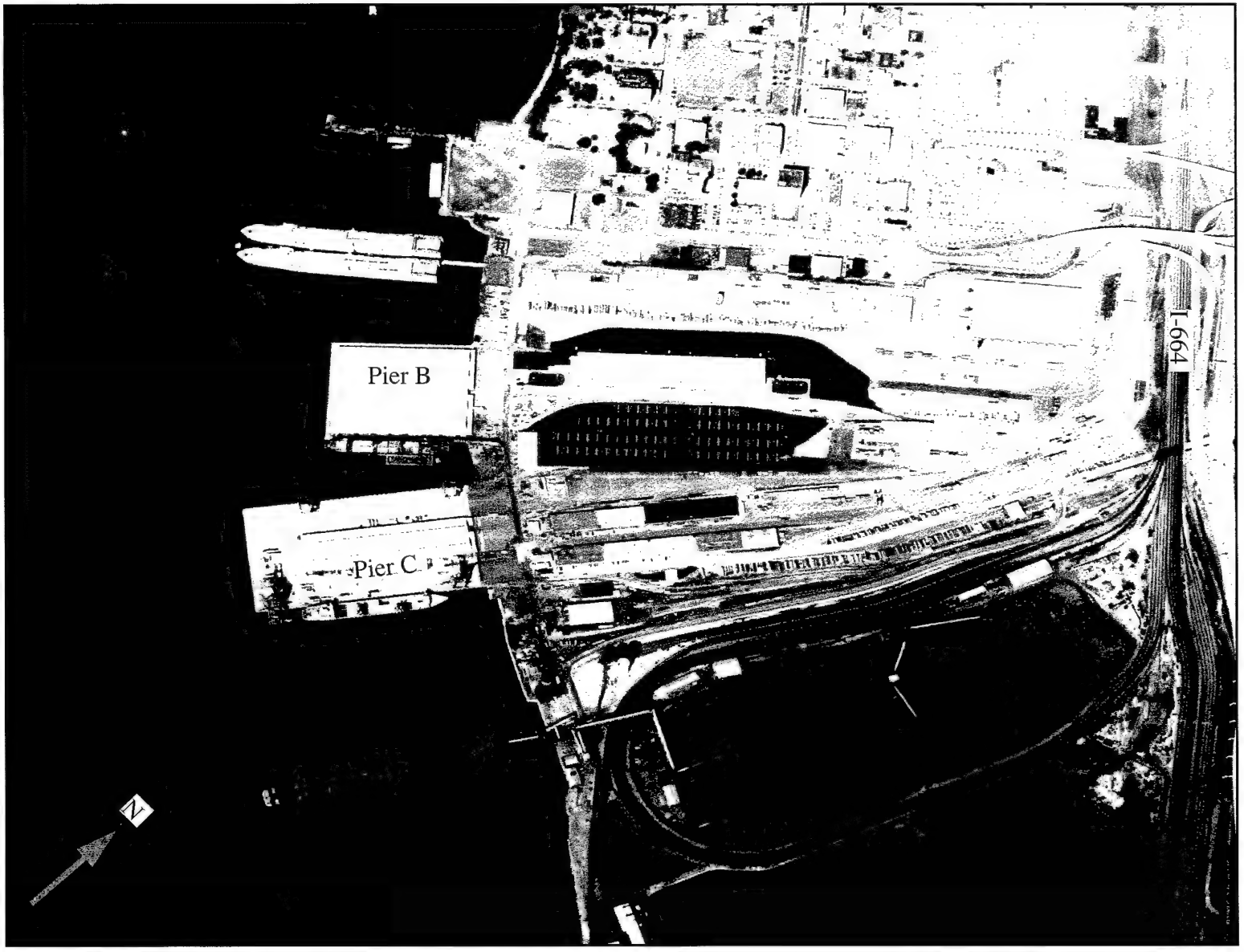
This report covers four terminals. The terminals are: Newport News Marine Terminal (NNMT), Norfolk International Terminal (NIT), Lamberts Point Docks (LPD), and Portsmouth Marine Terminal (PMT). These terminals are a mixture of breakbulk and container facilities consisting of marginal wharves and finger piers. Some facilities have transit sheds on the piers to support conventional breakbulk cargo.

Pier construction varies from terminal to terminal. Many of the terminals have apron tracks as well as wharf and/or container cranes. Water depth ranges from 28 to 40 feet MLW.

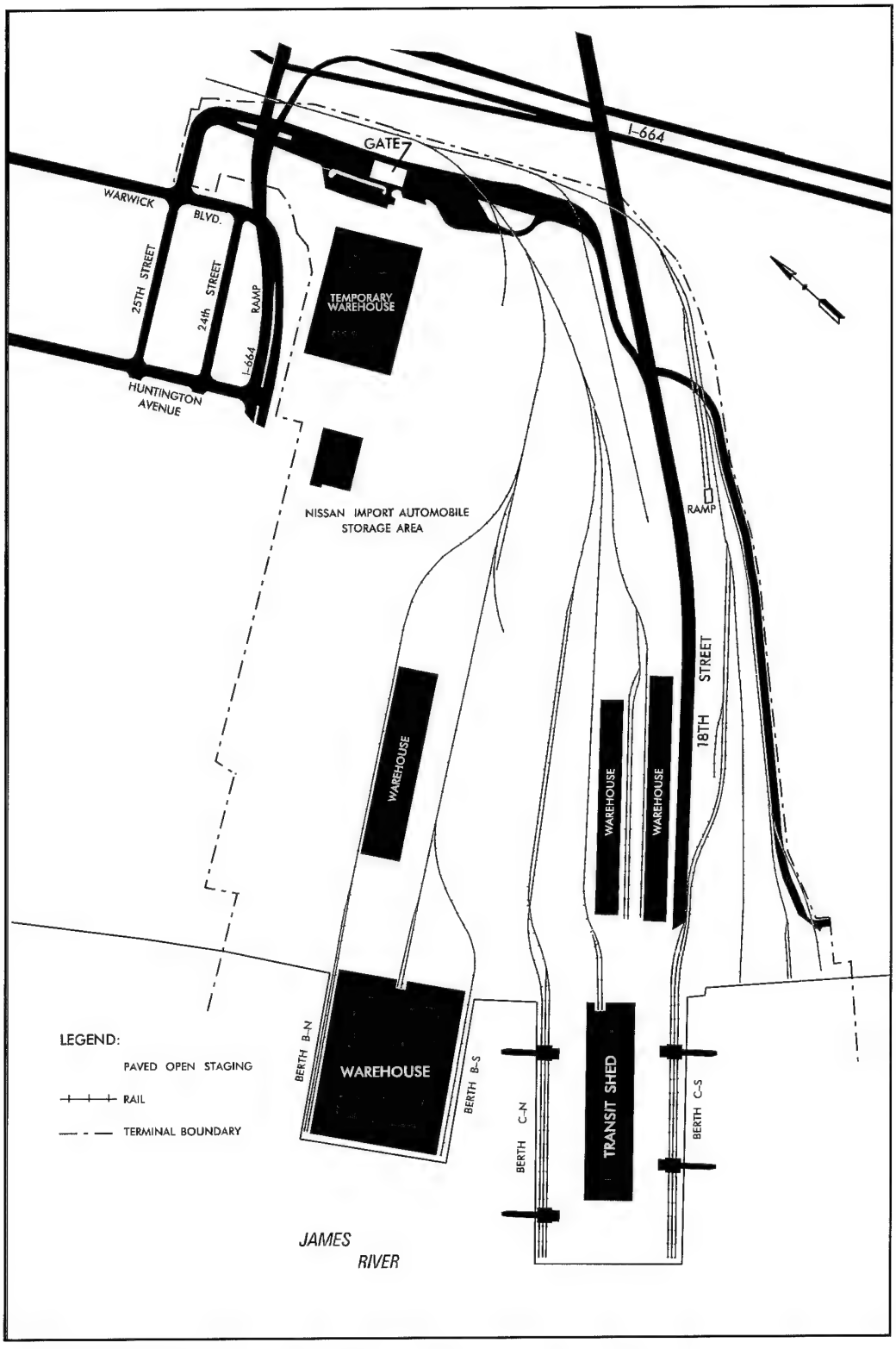
This section contains land-use maps and aerial views of the terminals. Also included are tables identifying the berth characteristics.

BERTHING CHARACTERISTICS OF NEWPORT NEWS MARINE TERMINAL

Characteristics	Berths			
	B-N	B-S	C-N	C-S
Length (ft)	620	620	960	960
Depth alongside at MLW (ft)	28	34	40	40
Deck strength (psf)	750	750	750	750
Apron width (ft)	34	34	Open	Open
Apron height above MLW (ft)	13.2	13.2	13.2	13.2
Number of container cranes	0	0	2	2
Number of wharf cranes	0	0	0	0
Apron lighting	Yes	Yes	Yes	Yes
Straight-stern RORO facilities	No	No	No	Yes
Apron length served by rail (ft)	620	620	780	960

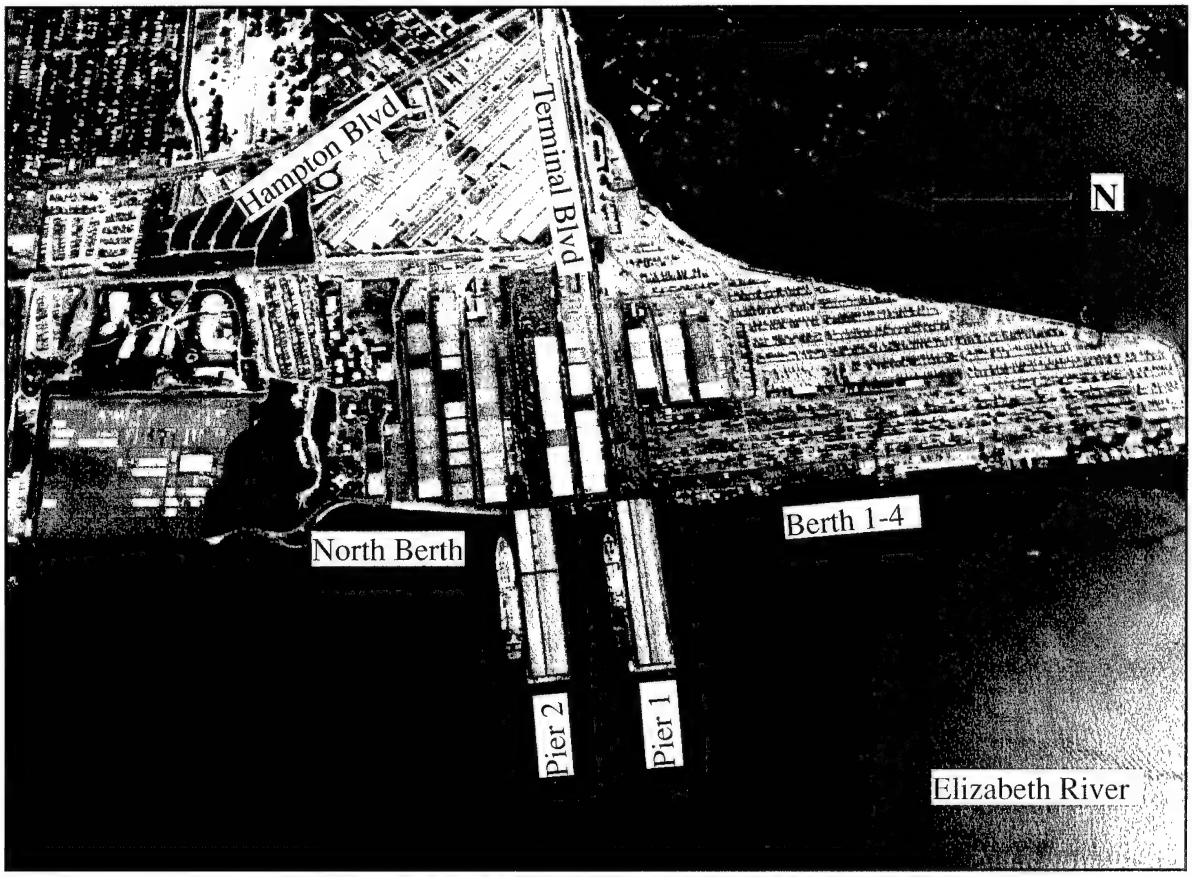


Newport News Marine Terminal

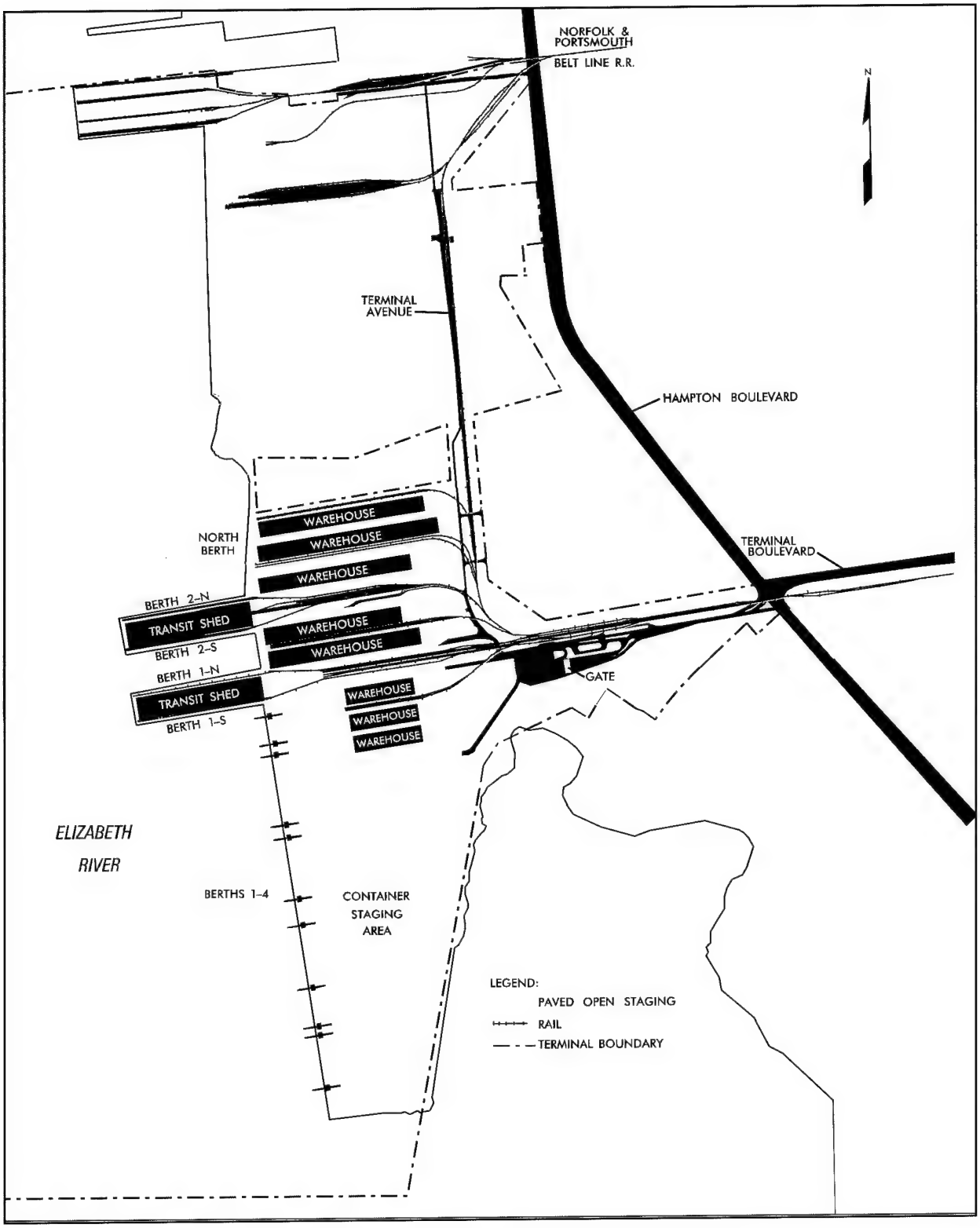


Newport News Marine Terminal Land-Use Map

BERTHING CHARACTERISTICS OF NORFOLK INTERNATIONAL TERMINAL						
Characteristics	**Berths**					
	1-4	**1-S**	**1-N**	**2-S**	**2-N**	**North Berth**
Length (ft)	4,230	1,328	1,328	1,328	1,328	900
Depth alongside at MLW (ft)	39	37	37	33	33	36
Deck strength (psf)	750	750	750	750	750	750
Apron width (ft)	Open	40	40	40	40	80
Apron height above MLW (ft)	9	9	9	9	9	9
Number of container cranes	7	0	0	0	0	0
Number of wharf cranes	0	0	0	0	0	0
Apron lighting	Yes	Yes	Yes	Yes	Yes	Yes
Straight-stern RORO facilities	No	Yes	Yes	Yes	Yes	No
Apron length served by rail (ft)	0	1,320	1,320	1,320	1,320	900



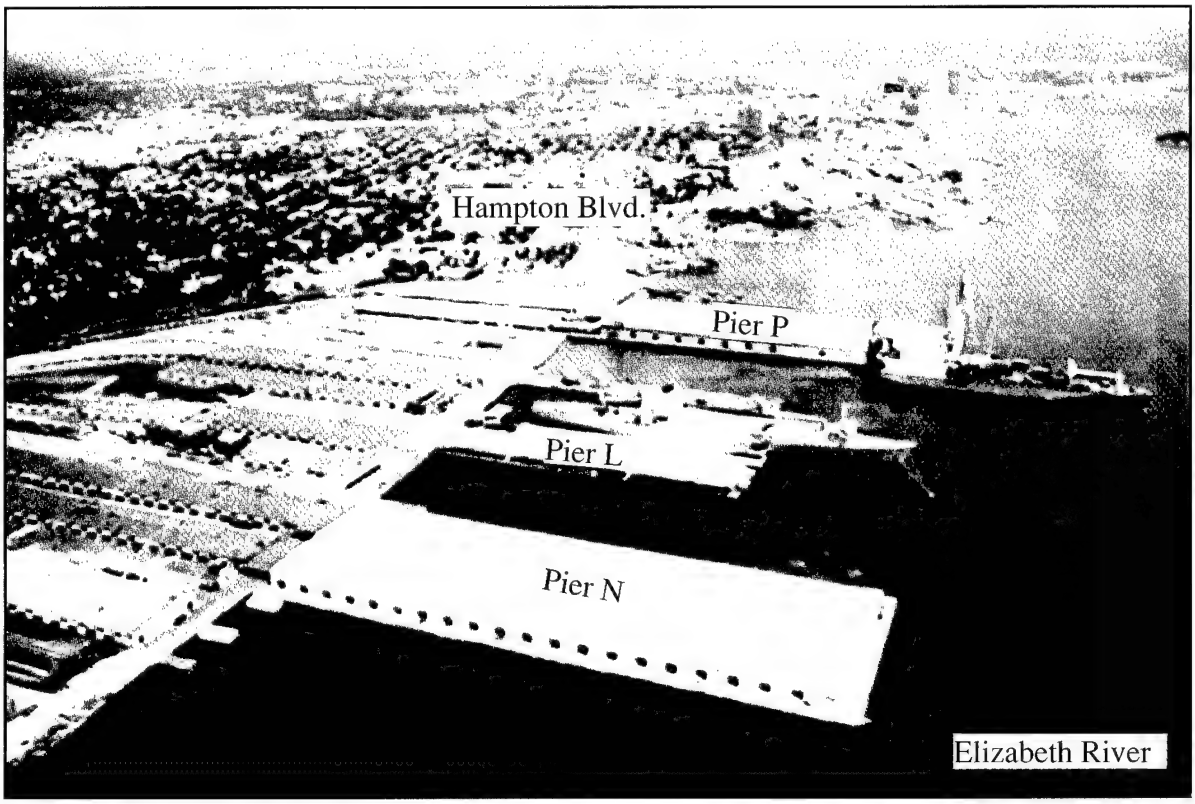
Norfolk International Terminal



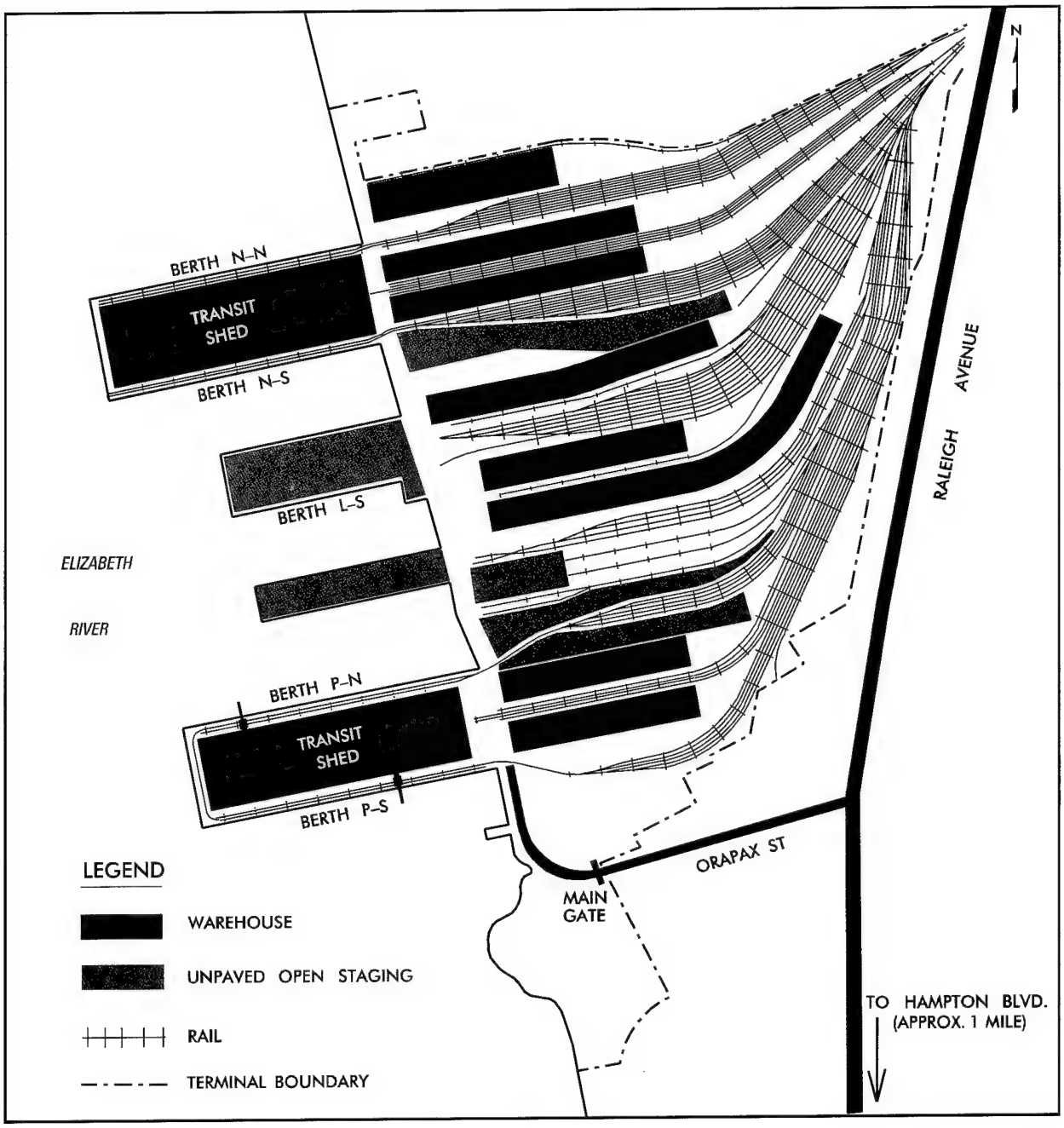
Norfolk International Terminal Land-Use Map

BERTHING CHARACTERISTICS OF LAMBERT'S POINT DOCKS TERMINAL

Characteristics	Berths				
	N-S	N-N	L-S	P-S	P-N
Length (ft)	1,100	1,100	725	1,200	1,200
Depth alongside at MLW (ft)	32	32	32	32	32
Deck strength (psf)	750	750	650	700	700
Apron width (ft)	35	35	Open	43	43
Apron height above MLW (ft)	11	11	9	11	11
Number of container cranes	0	0	0	0	0
Number of wharf cranes	0	0	0	1	1
Apron lighting	Yes	Yes	Yes	Yes	Yes
Straight-stern RORO facilities	No	No	No	Yes	Yes
Apron length served by rail (ft)	1,100	1,100	0	1,200	1,200

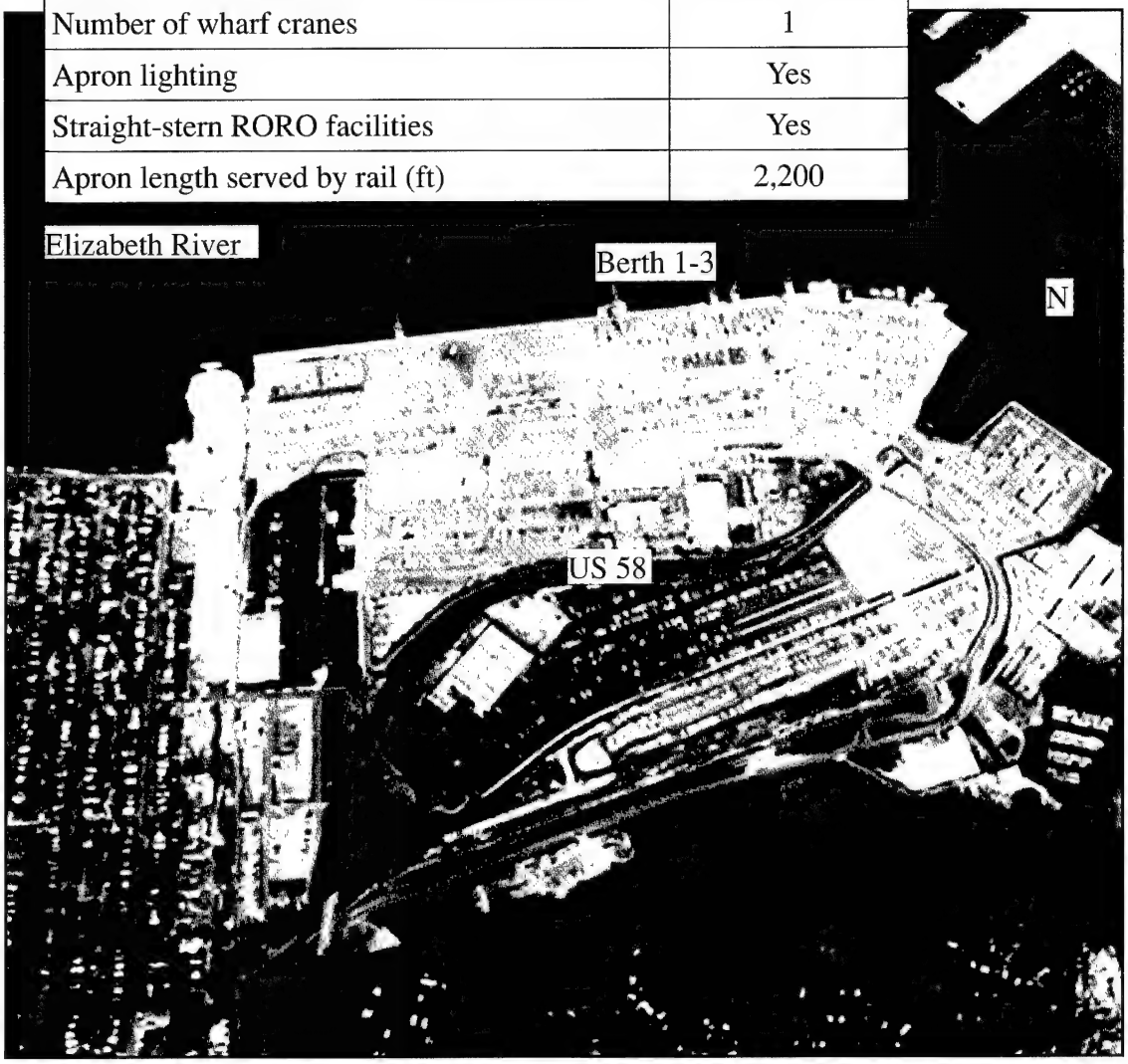


Lamberts Point Docks (Southward view)

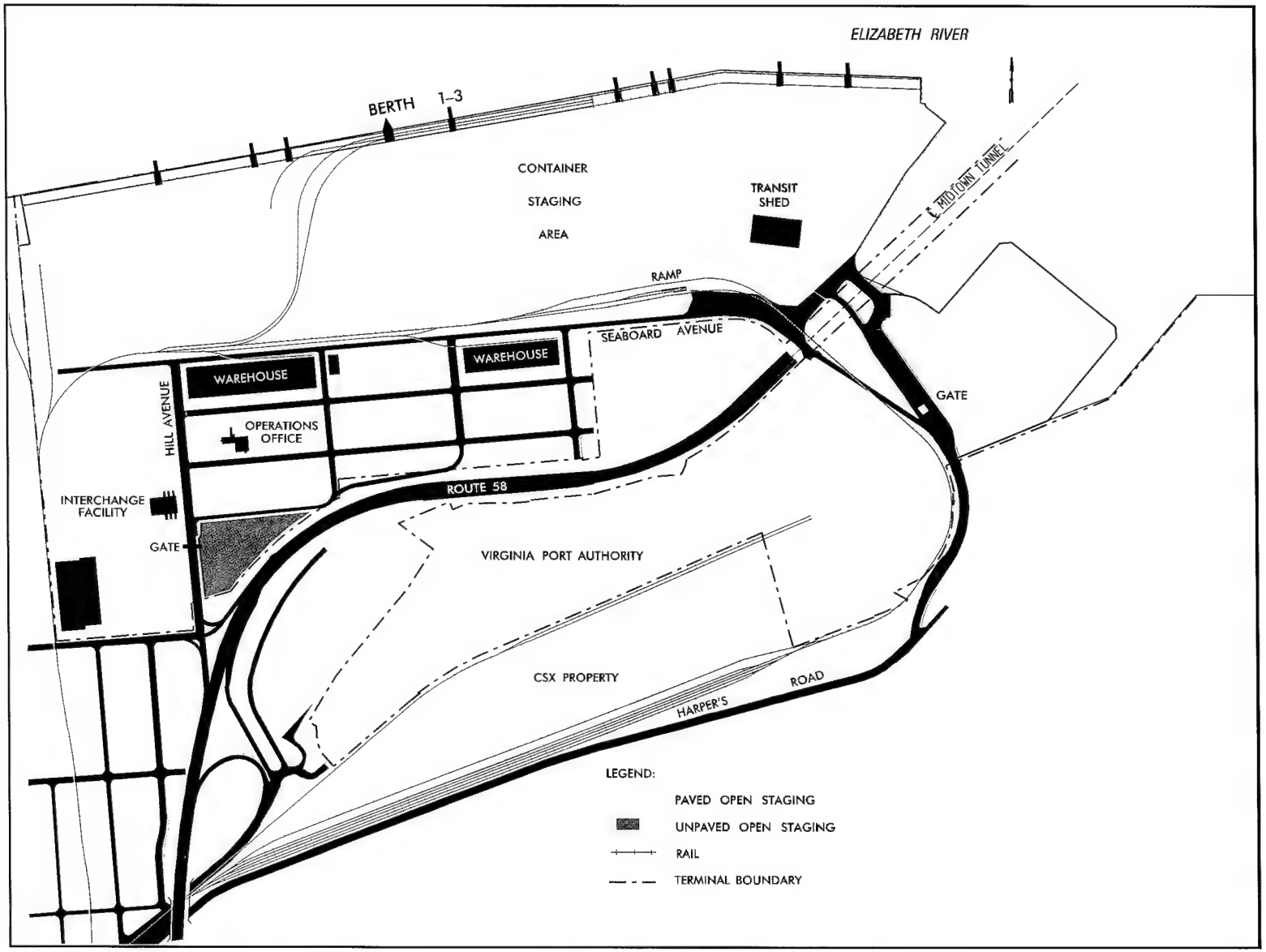


Lamberts Point Docks Land-Use Map

BERTHING CHARACTERISTICS OF PORTSMOUTH MARINE TERMINAL	
Characteristics	**Berths**
	1-3
Length (ft)	3,540
Depth alongside at MLW (ft)	40
Deck strength (psf)	750
Apron width (ft)	Open
Apron height above MLW (ft)	12
Number of container cranes	5
Number of wharf cranes	1
Apron lighting	Yes
Straight-stern RORO facilities	Yes
Apron length served by rail (ft)	2,200



Portsmouth Marine Terminal



Portsmouth Marine Terminal Land-Use Map

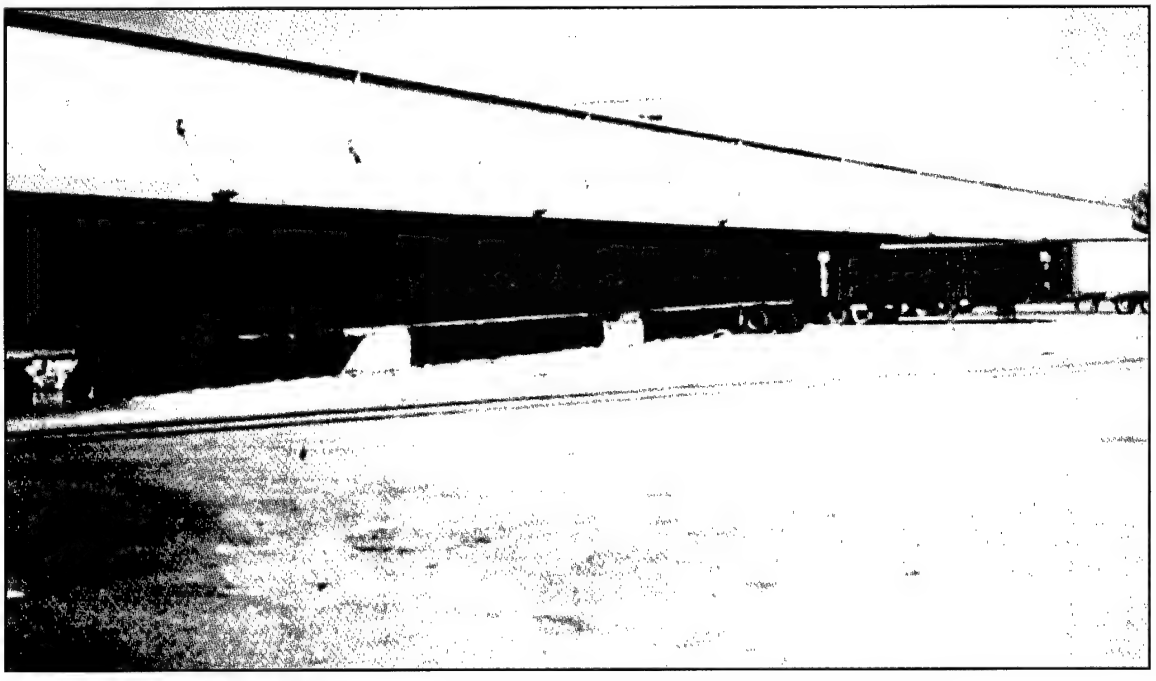
Staging

Open Staging. The terminals in this report have a total of 432 acres of open staging, of which 357 acres are paved. Helicopter operations are possible in open storage areas at NNMT, NIT, and PMT. Staging area locations at each terminal are identified below.

Covered Staging. The terminals have a total of 28 covered storage facilities (transit sheds and warehouses) that provide about 3,696,000 square feet of storage. The table below identifies the location of staging areas by terminal.

STAGING AREAS

TERMINAL	COVERED (SQ. FT)	OPEN PAVED (ACRES)	OPEN GRAVEL (ACRES)
NEWPORT NEWS MARINE TERMINAL	906,000	40	0
NORFOLK INT.TERMINAL	1,025,000	220	0
LAMBERT'S POINT DOCKS	1,605,000	0	25
PORTSMOUTH MARINE TERMINAL	160,400	147	0



Covered Staging at Lamberts Point Docks (eastward view)

Rail

CSX and Norfolk Southern provide service to the four terminals. Rail trackage links the railyards to the terminal's apron tracks, transit sheds, and storage tracks. All the rail serving the terminals is in good condition with no operating restrictions. There are numerous locations that could support offloading with temporary or portable ramps. The table below provides characteristics of the rail facilities at each terminal.

RAIL CHARACTERISTICS

TERMINAL	TERMINAL TRACK (FT)*	STORAGE CAPACITY (89-FT RAIL-CARS)**	RAMPS (#)	DOCK POSITIONS
NEWPORT NEWS MARINE TERMINAL	20,000	90	NONE	19
NORFOLK INT. TERMINAL	80,000	690	PERMANENT (3)	40
LAMBERT'S POINT DOCKS	130,600	1100	PERMANENT (3)	68
PORTSMOUTH MARINE TERMINAL	6,300	43	PORTABLE (3)	0

* Excluding apron track.
**Storage capacity based on rail spurs and sidings.

Marshaling Areas

No suitable marshaling areas are within or near NNMT, NIT, or LPD. The Virginia Port Authority has access to approximately 160 acres of unimproved area next to PMT. This area could be used to stage equipment, if necessary. Roadable vehicles and equipment could also be marshaled at Fort Eustis, about 19 miles north of NNMT.

MATERIAL HANDLING EQUIPMENT (MHE)

The terminals have a total of 17 container cranes that are at NNMT, NIT and PMT. All have a capacity of at least 30 STON. Various shipping and rental companies in the area own transtainers and other MHE. Mobile cranes with capacities up to 150 STON are available from local stevedore companies. The table below provides the equipment available by terminal.

TYPE OF EQUIPMENT	CAPACITY (STON)	QUANTITY BY TERMINAL			
		NNMT	NIT	LPD	PMT
Container Cranes	30-200	4	7	0	5
Wharf Cranes	3-35	0	0	2	1
Mobile Cranes	10-150	1	4	3	5
Straddle Carriers	40	0	0	0	26
Transtainers	30-40	5	22	2	0
Top Picks	30-45	3	0	2	2

INTERMODAL FACILITIES

Intermodal container transfers are handled at all four terminals. Norfolk Southern operates a container transfer facility in Chesapeake, about 10 miles south of Norfolk International Terminal and Lambert's Point Docks.

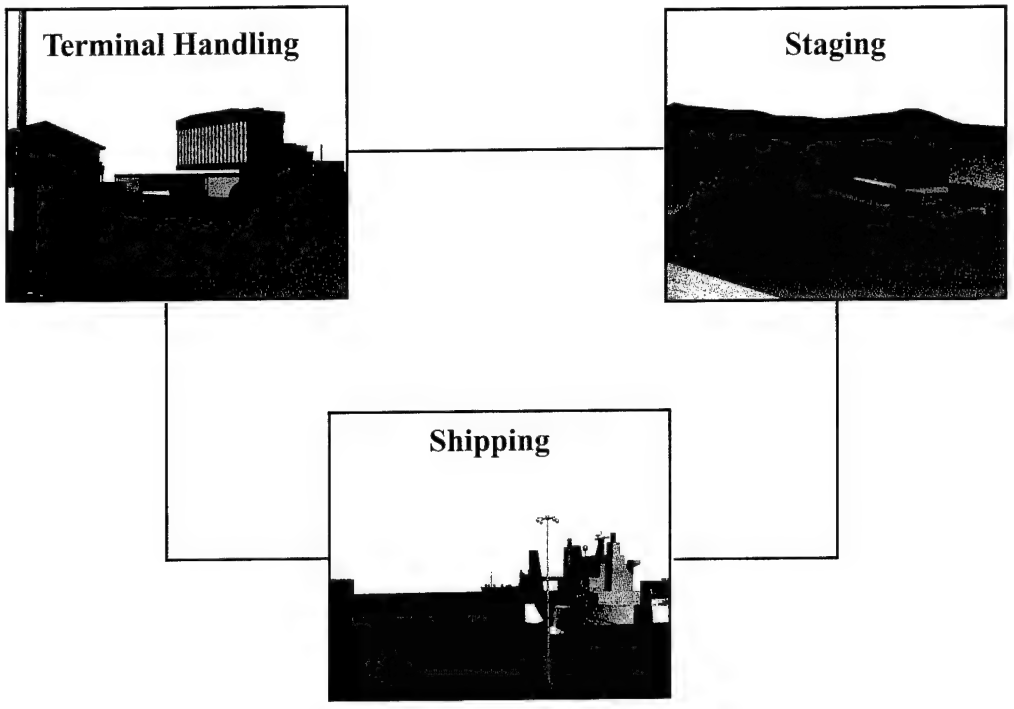
FUTURE DEVELOPMENT

NIT has plans for expansion to the north of the terminal. The expansion includes dock construction, dredging, and a paved container storage and trailer parking area. The north berth will be expanded to create a total of 4,300 feet of wharf for use by containerships.

II. THROUGHPUT ANALYSIS

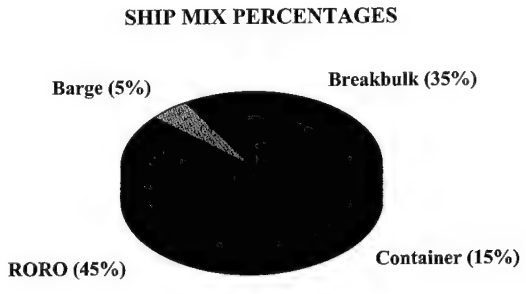
GENERAL

This section evaluates the throughput capability of the Port of Hampton Roads using the port operational performance simulator (POPS) computer model. The model is based on a weak-link analysis in which each subsystem is analyzed separately and then compared to find the least capable subsystem. The weakest subsystem defines the maximum throughput capability of the terminal. The model yields throughput capability values for three subsystems - shipping, staging, and terminal processing/handling - in measurement tons (MTON) per day



Terminal Throughput Subsystems

This analysis assumes a maximum of 80 percent of the port facilities can be made available at any one time. For this reason, we ran all port analyses using an 80 percent facility use factor. Also, the ship mix is based on Desert Shield and Desert Storm statistics. We weighted the percentages to adjust for differences in cargo deadweights and expectations for future deployments.



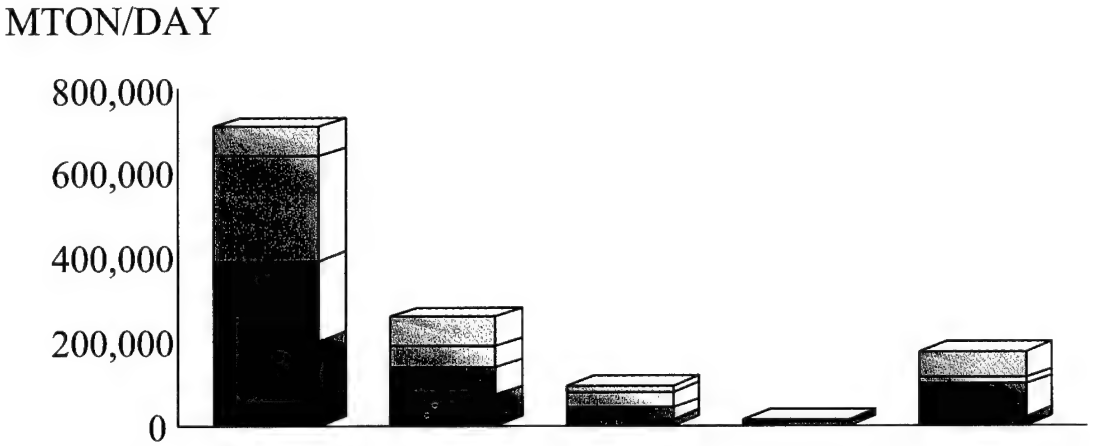
RECEPTION/HANDLING

Highway. I-64, -664, and -264 provide access to the terminals. Each terminal has a designated entrance for trucks. The road network in and out of the terminals, including the gate processing of vehicles, could handle about 260,000 MTON of equipment and supplies per day.

Roadable vehicles in convoys will process directly to the staging areas. Vehicles on commercial or military flatbed trailers without integral ramps will offload at permanent and portable end ramps.

Supplies in van semitrailers will proceed to van-handling positions. These docks can offload more than 1,800 MTON of van semitrailer-shipped material per day. Container handlers can off-load about 146,000 MTON of chassis cargo per day.

HIGHWAY RECEPTION/HANDLING CAPABILITY



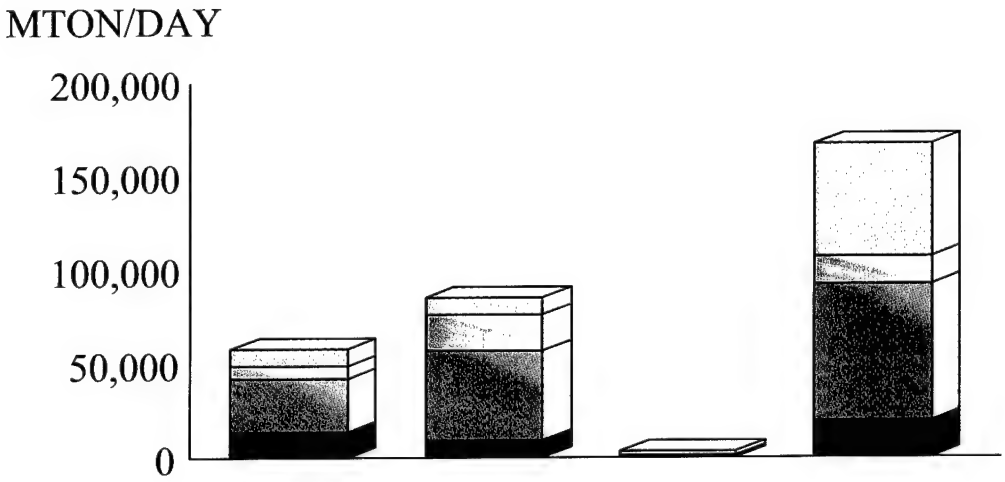
SUBSYSTEMS	HIGHWAY	GATES	END-RAMPS	DOCKS	CONTAINERS
NNMT	200,000	72,000	14,000	7,000	20,000
NIT	190,000	65,000	29,000	4,000	77,000
LPD	250,000	50,000	38,000	4,000	15,000
PMT	70,000	72,000	14,000	0	64,000

Rail

Rail reception at the port is good with three railroad companies accessing the Port of Hampton Roads area. All terminals have good rail service.

Terminal	Train Length (railcars)	Trains Per Day
NNMT	60	2
NIT	60	4
LPD	30	2
PMT	40	2

RAIL RECEPTION/HANDLING CAPABILITY

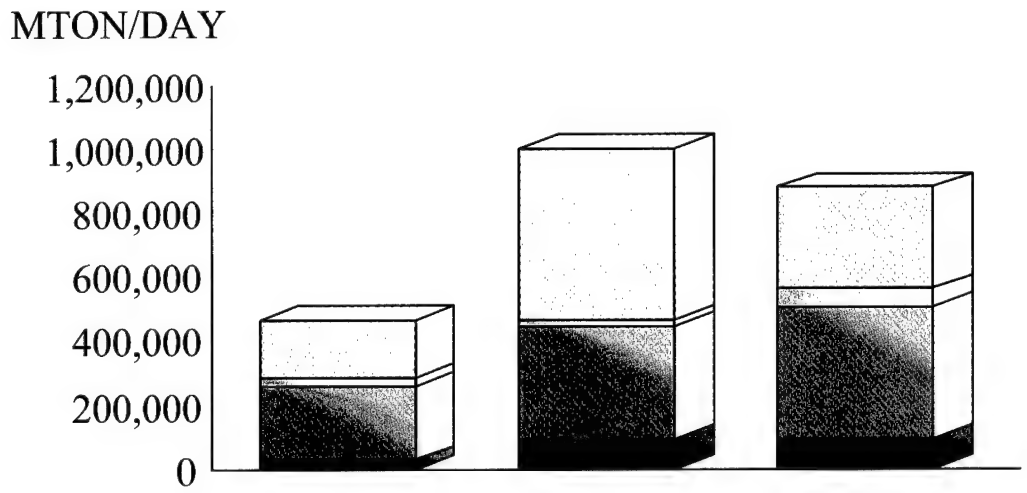


SUBSYSTEMS	TRACKAGE	END-RAMPS	DOCKS	COFC
NNMT	14,000	9,100	680	19,000
NIT	28,000	48,000	600	73,000
LPD	6,900	19,000	1,800	15,000
PMT	8,900	9,100	0	61,000

STAGING

The terminals of this report have a total of about 407 acres of paved open staging. The terminals also have more than 3.2 million square feet of covered storage.

OPEN STAGING CAPABILITY

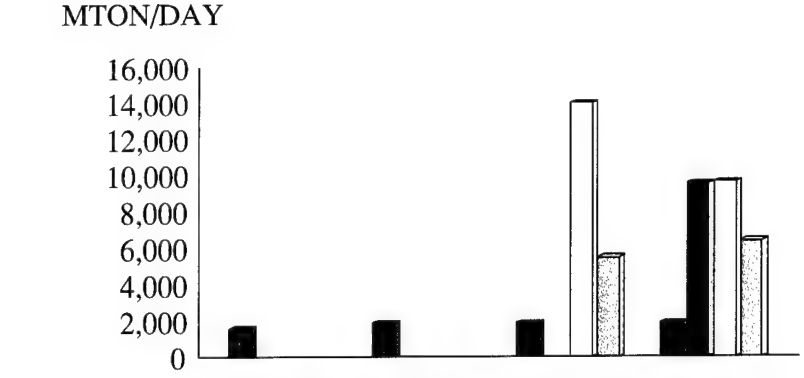


	RORO	CONTAINERS	BREAKBULK
NNMT	29,000	92,000	93,000
NIT	230,000	350,000	410,000
LPD	27,000	22,000	58,000
PMT	180,000	540,000	320,000

SHIPPING

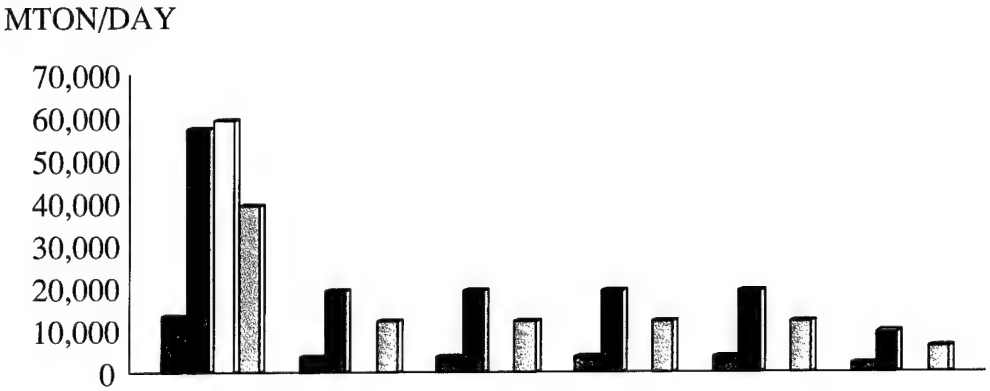
Throughputs for each berth are shown below. They are based on various factors including MHE used, loading, operational, and berth usage rates as well as berth/ship compatibility.

NEWPORT NEWS MARINE TERMINAL
BERTH THROUGHPUT CAPABILITY



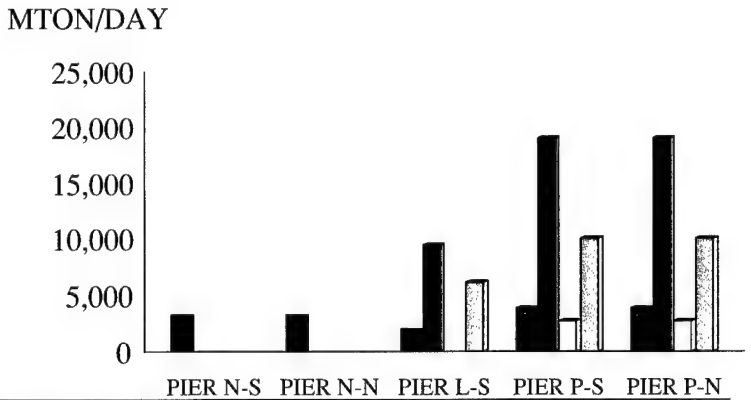
	PIER B-N	PIER B-S	PIER C-N	PIER C-S
BREAKBULK	1,600	1,900	1,900	1,900
RORO	0	0	0	9,500
CONTAINER	0	0	14,000	9,600
MIXED	0	0	5,500	6,400

NORFOLK INTERNATIONAL TERMINAL
BERTH THROUGHPUT CAPABILITY



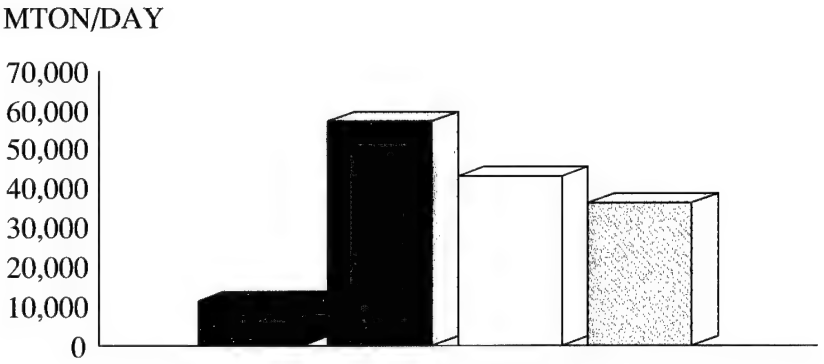
	BERTH 1	PIER 1-S	PIER 1-N	PIER 2-S	PIER 2-N	NORTH BERTH
BREAKBULK	13,000	3,700	3,700	3,700	3,700	1,900
RORO	57,000	19,000	19,000	19,000	19,000	9,400
CONTAINER	59,000	0	0	0	0	0
MIXED	39,000	12,000	12,000	12,000	12,000	6,000

LAMBERT'S POINT DOCKS
BERTH THROUGHPUT CAPABILITY



	PIER N-S	PIER N-N	PIER L-S	PIER P-S	PIER P-N
BREAKBULK	3,200	3,200	1,900	3,800	3,800
RORO	0	0	9,400	19,000	19,000
CONTAINER	0	0	0	2,700	2,700
MIXED	0	0	6,100	10,000	10,000

PORTSMOUTH MARINE TERMINAL
BERTH THROUGHPUT CAPABILITY



	BERTH 1-3
BREAKBULK	11,000
RORO	57,000
CONTAINER	43,000
MIXED	36,000

CONVERSION FACTORS	
Breakbulk:	0.4 STON per MTON
RORO:	.25 STON per MTON
Containers:	0.4 STON per MTON

The type of ship preferred at each berth is based on the methodology described in Appendix B. The evaluation is based on a snapshot view of the current physical characteristics of the berths and the MHE available. The evaluation below gives no considerations for enhancements, such as equipment. The lower the number for a berth, the better the berth is suitable for loading and unloading operations.

NIT best supports FSS and LMSR operations. An FSS would likely berth at berth 1-4, with port side to the wharf. LMSR vessels can also load at this berth without loading restrictions.

PREFERENCE BERTH SELECTION

BERTH	BB	RORO	CNTNR
NNMT			
Pier Bn	-	-	-
Pier Bs	3	-	9
Pier Cn	1	-	10
Pier Cs	2	3	3
NIT			
Berth 1-4	6	1	1
Pier 1	3	4	3
Pier 2	3	5	3
N. Berth	10	2	3
LPD			
Pier N	8	-	8
Pier L	11	-	10
Pier P	8	-	3
PMT			
Berth 1-3	6	6	1

SUMMARY OF BERTHING CAPABILITIES OF NEWPORT NEWS MARINE TERMINAL

Vessel	Berths			
	Pier BN	Pier BS	Pier CN	Pier CS
Breakbulk				
C3-S-33a	a	1	1	1
C3-S-37c	a	1	1	1
C3-S-37d	a	1	1	1
C3-S-38a	1	1	1	1
C4-S-1a	a	1	1	1
C4-S-1qb and 1u	a	1	1	1
C4-S-58a	a	1	1	1
C4-S-65a	a	1	1	1
C4-S-66a	a	1	1	1
C4-S-69b	a	1	1	1
Seatrain				
GA and PR-class	1	1	1	1
Barge				
LASH C8-S-81b	a,c,f	a,c,f	1	1
LASH C9-S-81d	a,c	a,c	1	1
LASH lighter	4	4	6	6
SEABEE C8-S-82a	a,c	a,c	1	1
SEABEE barge	3	3	4	4
RORO				
Comet	d,o	d,o	d,i,,j	i,j
C7-S-95a/Maine-class	a,b,c	b,c	1	1
Ponce-class	b,c,h	b,c,h	h	h
Great Land-class	b,c,h	b,c,h	h	h
Cygnus/Pilot-class	b,c	b,c	1	1
Meteor	a,d,o	d,o	d,i,j	i,j
AmEagle/Condor	a,b,c	b,c	i,j	i,j
MV Ambassador	d	d	d	1
FSS-class	a,b,c	b,c	1	1
Cape D-class	a,b,c	b,c	i,j	i,j
Cape H-class	a,b,c	a,b,c	1	1
LMSR	a,b,c	b,c	1	1
Container				
C6-S-1w	a,c,e	c,e	1	1
C7-S-68e	a,c,e	c,e	1	1
C8-S-85c	a,c,e	c,e	c	1
Combination				
C5-S-78a	a,e	1,e	1	1
C5-S-37e	a,e	1,e	1	1

a=vessel draft limited to berth depth
b=inadequate apron width
c=inadequate berth length
d=no straight stern-ramp facilities
e=no container-handling equipment
f=shallow berth, adequate anchorage depth
g=inadequate channel depth
h=no shore-based ramps available
i=insufficient ramp clearance at low tide
j=insufficient ramp clearance at high tide
k=excessive ramp angle at low tide
m=excessive ramp angle at high tide
n=parallel ramp operation only
o=too narrow apron for side-ramp

Notes: Ramp clearance and ramp angle based on maximum vessel draft
( ) indicates vessels assigned by analyst

SUMMARY OF BERTHING CAPABILITIES OF NORFOLK INTERNATIONAL TERMINAL

Vessel	Berths					
	Berth 1-4	Pier 1S	Pier 1N	Pier 2S	Pier 2N	North Berth
Breakbulk						
C3-S-33a	8	2	2	2	2	1
C3-S-37c	8	2	2	2	2	1
C3-S-37d	8	2	2	2	2	1
C3-S-38a	8	2	2	2	2	1
C4-S-1a	7	2	2	2	2	1
C4-S-1qb and 1u	7	2	2	2	2	1
C4-S-58a	7	2	2	2	2	1
C4-S-65a	7	2	2	2	2	1
C4-S-66a	7	2	2	2	2	1
C4-S-69b	7	2	2	2	2	1
Seatrain						
GA and PR-class	7	2	2	2	2	1
Barge						
LASH C8-S-81b	5	1	1	a,f	a,f	1
LASH C9-S-81d	4	a	a	a	a	a
LASH lighter	30	9	9	9	9	6
SEABEE C8-S-82a	4	a	a	a	a	a
SEABEE barge	21	6	6	6	6	4
RORO						
Comet	d,i,j	i,j	i,j	i,j	i,j	d,i,j
C7-S-95a/Maine-class	5	b	b	a,b	a,b	a
Ponce-class	h	b,h	b,h	b,h	b,h	b,h
Great Land-class	h	b,h	b,h	b,h	b,h	b,h
Cygnus/Pilot-class	6	b	b	b	b	1
Meteor	d,i,j	i,j	i,j	i,j	i,j	d,i,j
AmEagle/Condor	i,j	b	b	b	b	i,j
MV Ambassador	d	2,m	2,m	2,m	2,m	d
FSS-class	4	b	b	a,b	a,b	c
Cape D-class	i,j	b	b	b	b	i,j
Cape H-class	5	b	b	a,b	a,b	1
LMSR	4	b	b	a,b	a,b	c
Container						
C6-S-lw	6	1,e	1,e	1,e	1,e	1,e
C7-S-68e	5	1,e	1,e	1,e	1,e	1,e
C8-S-85c	4	1,e	1,e	1,e	1,e	1,e
Combination						
C5-S-78a	6	2,e	2,e	a,e	a,e	1,e
C5-S-37e	6	2,e	2,e	2,e	2,e	1,e

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e=no container-handling equipment
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j=insufficient ramp clearance at high tide
k=excessive ramp angle at low tide
m=excessive ramp angle at high tide
n=parallel ramp operation only
o=too narrow apron for side-ramp

Notes: Ramp clearance and ramp angle based on maximum vessel draft
( ) indicates vessels assigned by analyst

SUMMARY OF BERTHING CAPABILITIES OF LAMBERTS POINT DOCKS

Vessel	Berths				
	Pier N-S	Pier N-N	Pier L-S	Pier P-S	Pier P-N
Breakbulk					
C3-S-33a	2	2	1	2	2
C3-S-37c	2	2	1	2	2
C3-S-37d	2	2	1	2	2
C3-S-38a	2	2	1	2	2
C4-S-1a	1	1	1	2	2
C4-S-1qb and 1u	1	1	1	2	2
C4-S-58a	1	1	1	2	2
C4-S-65a	1	1	1	2	2
C4-S-66a	a	a	a	a	a
C4-S-69b	1	1	1	2	2
Seatrain					
GA and PR-class	1	1	1	2	2
Barge					
LASH C8-S-81b	a,f	a,f,	a,c,f	a,f	a,f
LASH C9-S-81d	a	a	a,c	a	a
LASH lighter	7	7	5	8	8
SEABEE C8-S-82a	a	a	a,c	a	a
SEABEE barge	5	5	3	6	6
RORO					
Comet	d,o	d,o	d,i,j	i,j	i,j
C7-S-95a/Maine-class	a,b	a,b	a,c	a,b	a,b
Ponce-class	b,h	b,h	h	b,h	b,h
Great Land-class	b,h	b,h	c,h	b,h	b,h
Cygnus/Pilot-class	b	b	1	b	b
Meteor	d,o	d,o	d,i,j	i,j	i,j
AmEagle/Condor	b	b	1	b	b
MV Ambassador	d	d	d	2,m	2,m
FSS-class	a,b	a,b	a,c	a,b	a,b
Cape D-class	a,b	a,b	a	a,b	a,b
Cape H-class	a,b	a,b	a,c	a,b	a,b
LMSR	a,b	a,b	a,c	a,b	a,b
Container					
C6-S-1w	1,e	1,e	1,e	1,e	1,e
C7-S-68e	1,e	1,e	1,e	1,e	1,e
C8-S-85c	a,e	a,e	a,c,e	a,e	a,e
Combination					
C5-S-78a	a,e	a,e	a,e	a,e	a,e
C5-S-37e	1,e	1,e	1,e	1,e	1,e

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h=no shore-based ramps available
i=insufficient ramp clearance at low tide
j=insufficient ramp clearance at high tide
k=excessive ramp angle at low tide
m=excessive ramp angle at high tide
n=parallel ramp operation only
o=too narrow apron for side-ramp

Notes: Ramp clearance and ramp angle based on maximum vessel draft
( ) indicates vessels assigned by analyst

SUMMARY OF BERTHING CAPABILITIES OF PORTSMOUTH MARINE TERMINAL

Vessel	Berths
	1-3
Breakbulk	
C3-S-33a	6
C3-S-37c	6
C3-S-37d	6
C3-S-38a	6
C4-S-1a	6
C4-S-1qb and 1u	6
C4-S-58a	5
C4-S-65a	6
C4-S-66a	5
C4-S-69b	5
Seatrain	
GA and PR-class	6
Barge	
LASH C8-S-81b	4
LASH C9-S-81d	3
LASH lighter	25
SEABEE C8-S-82a	3
SEABEE barge	17
RORO	
Comet	i,j
C7-S-95a/Maine-class	4
Ponce-class	h
Great Land-class	h
Cygnus/Pilot-class	5
Meteor	i,j
AmEagle/Condor	i,j
MV Ambassador	6
FSS-class	3
Cape D-class	i,j
Cape H-class	4
LMSR	3
Container	
C6-S-1w	5
C7-S-68e	4
C8-S-85c	4
Combination	
C5-S-78a	5
C5-S-37e	5

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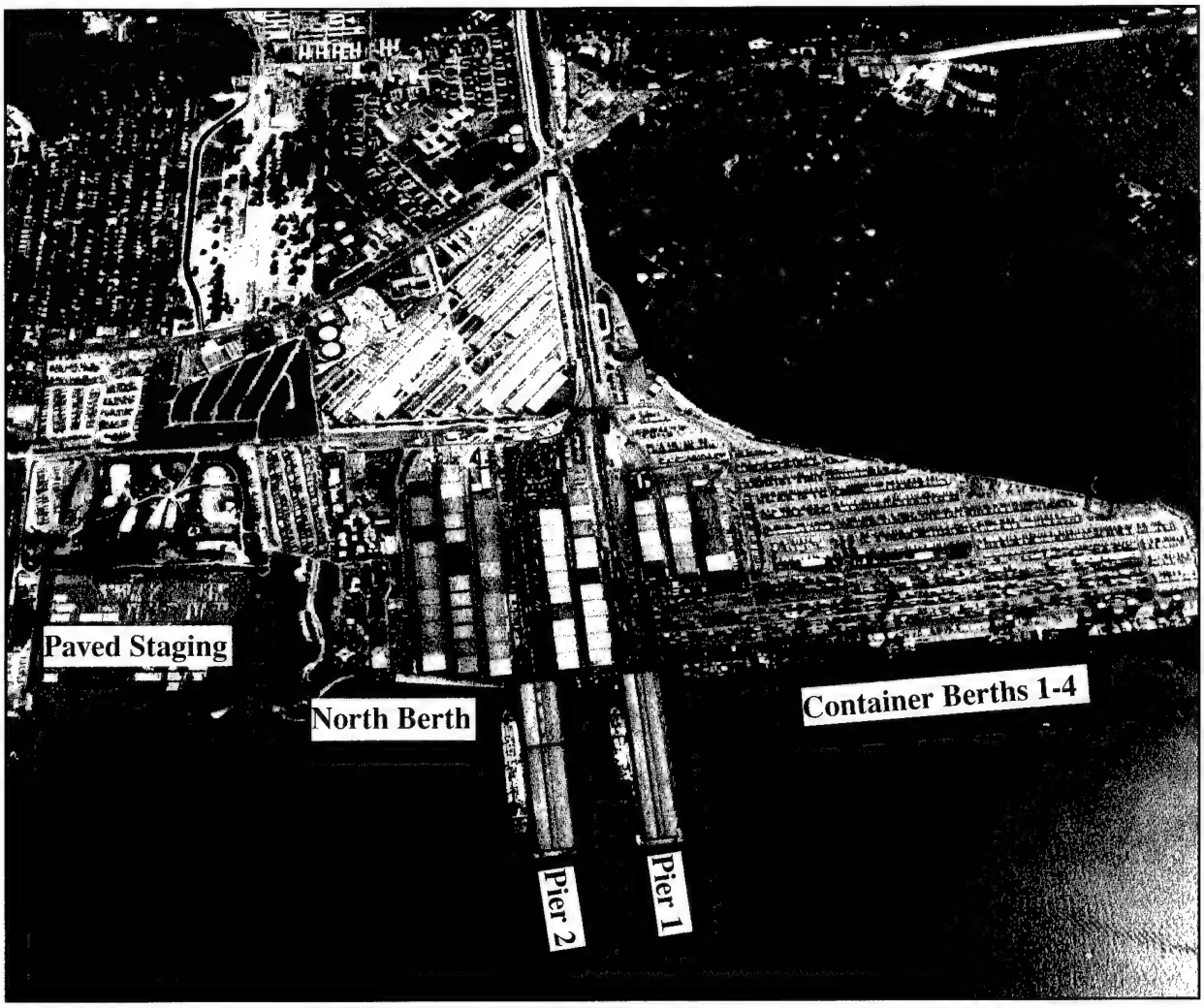
m=excessive ramp angle at high tide
n=parallel ramp operation only

Notes: Ramp clearance and ramp angle based on maximum vessel draft
( ) indicates vessels assigned by analyst

II. APPLICATION

GENERAL

This section evaluates the port's throughput capability for deploying a notional mechanized infantry division by primarily FSS vessels. The August 1994 revision of the ***Planning Orders Digest***, issued by MARAD, provided agreements for military use of the Port of Hampton Roads. The agreements referenced the Norfolk International Terminal to include all of Pier 2, the North Berth, Container Berths 1 and 2, and the paved staging area at the north end of the terminal. The agreements also referenced the NNMT to include all Pier C berths, transit sheds, and up to 200,000 square feet of open staging area. If the military needs to deploy through the Port of Hampton Roads, it will most likely use the NIT berths in Norfolk. The NNMT berth characteristics restrict their use by many of the vessels used for military operations. Furthermore, automobile operations at NNMT usually occupy the majority of open staging.



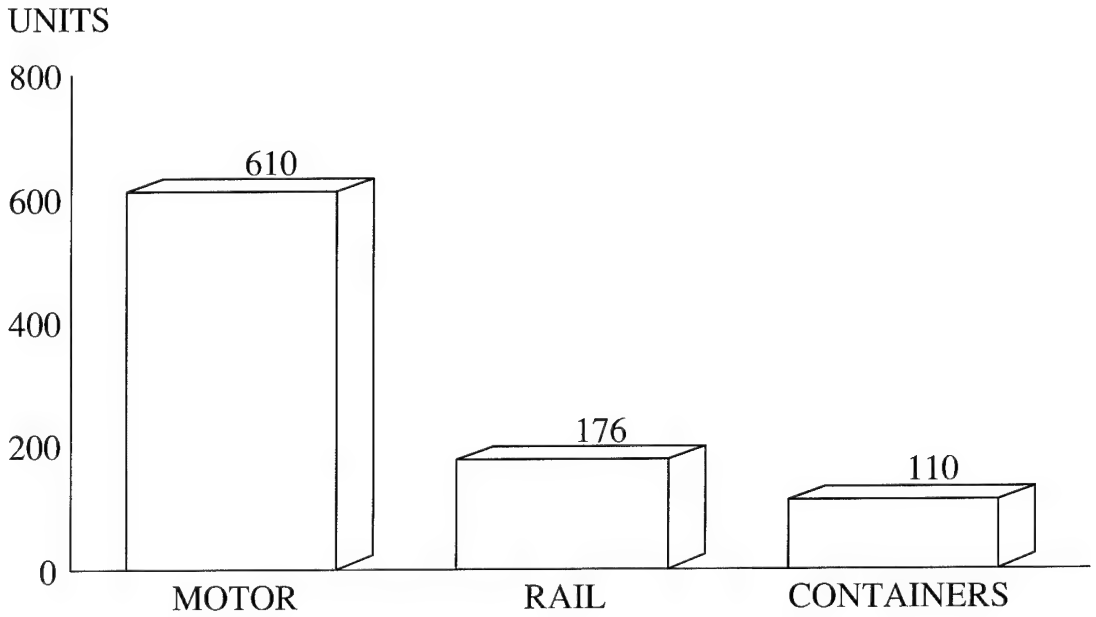
Norfolk International Terminal

REQUIREMENTS

The likely requirement for the Port of Hampton Roads is to deploy a notional mechanized infantry division in 6 days. The division has to move about 7,800 vehicles and 660 containers. The movement to the port will require 1,055 (176 per day) railcars using the convoy/rail option. Under this option, about 3,650 (610 per day) roadable vehicles would be driven and about 2,320 (387 per day) would be towed.

MECHANIZED INFANTRY DIVISION	
Total Equipment	
Volume	280,000 MTON
Weight	95,000 STON
Area	1,400,000 SQ FT
Vehicles	7,800
Containers	660

DAILY REQUIREMENTS

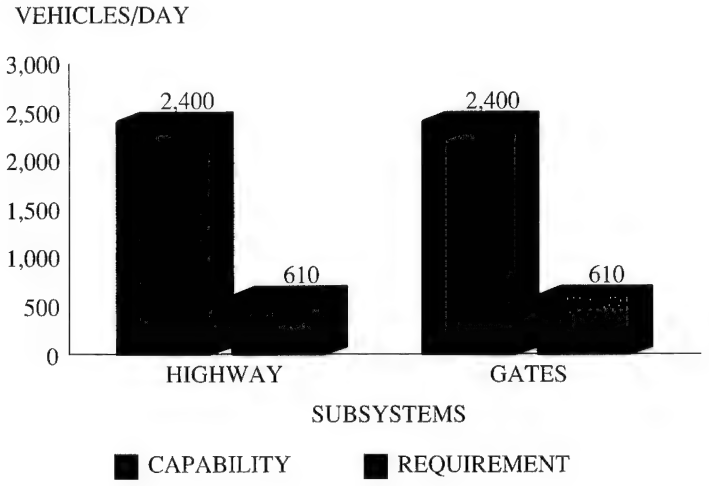


TERMINAL INPROCESSING/HANDLING

Highway

Vehicles and containers on chassis would access the terminals through the gates at Terminal Boulevard. The access roads and gates can handle well over 2,400 vehicles per day. Six portable ramps are available to support truck unloading operations.

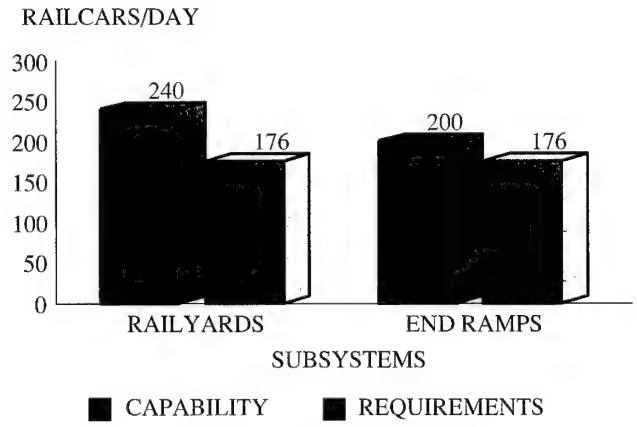
HIGHWAY INPROCESSING CAPABILITY



Rail

The NIT berths can receive about 240 railcars of military equipment per day. This is sufficient to

RAIL INPROCESSING AND HANDLING CAPABILITY



The terminal has three fixed end ramps with each ramp supporting 600 feet of rail. These ramps can support offloading about 72 railcars per day, assuming four switch cycles per day. Our analysis also assumes the MTMC port operator will provide two portable end ramps. These ramps placed at the 1,600-ft spurs inland of Pier 1 would support offloading an additional 128 railcars per day. The total of 200 railcars per day from all five ramps would meet the requirement.

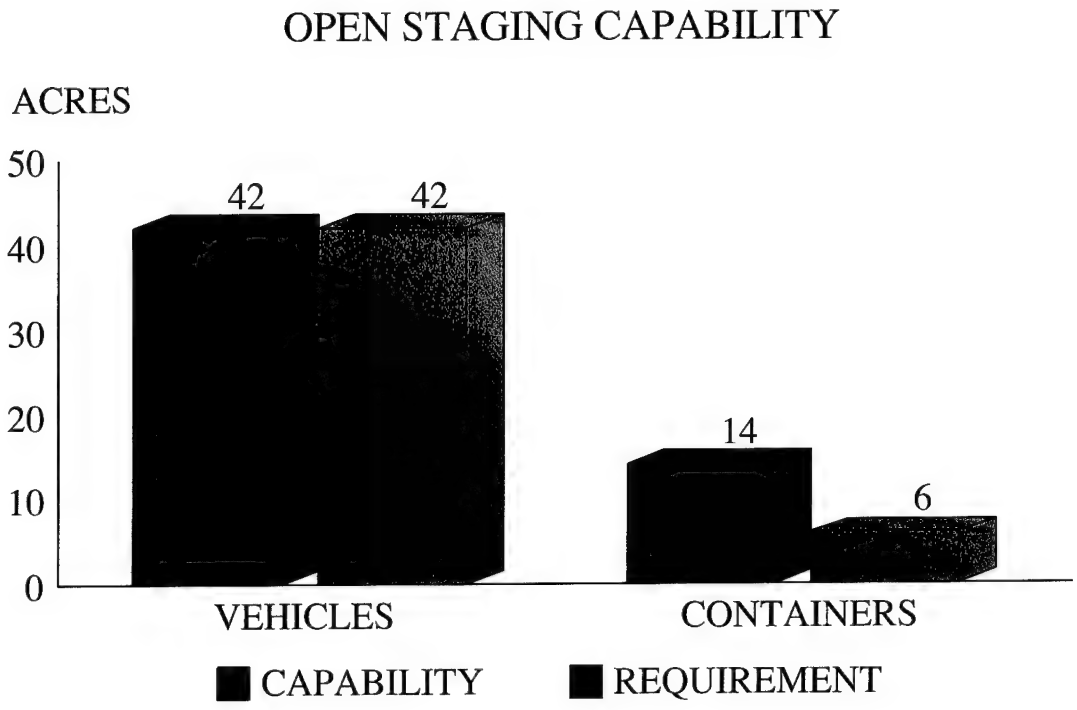
If necessary, the nearby LPD has three fixed and five portable ramps that support more than 3 miles of track. These facilities could be used to support rail operations.

STAGING

This analysis assumes that current downsizing continues, and that nine FSS-sized ships will deploy an entire notional mechanized infantry division. Three ships will depart every 2 days. Because of this, the staging requirement is to support three sustained loading operations.

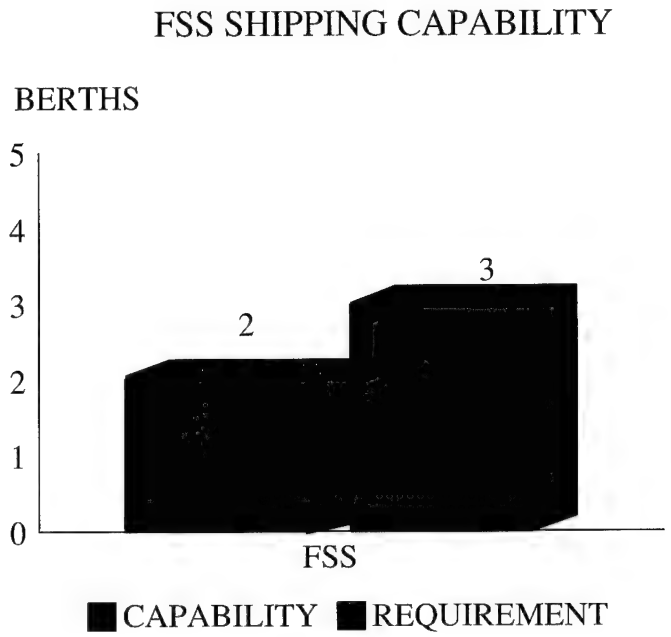
Although an FSS load of cargo can be staged and loaded on 10 acres, 16 acres are required for sustained loading operations. Of these 16 acres, about 2 acres are required for staging of the 73 containers for each FSS. The three simultaneous shiploading operations will require 48 acres of open staging, of which about 6 acres are dedicated to containers.

The Planning Orders provide for staging of about 56 acres located at the north end of the terminal. This is enough staging area to satisfy the requirement.



SHIPPING

Although this analysis assumes that only nine FSS-sized ships can deploy the notional mechanized infantry division, the table below provides ship quantities for the current division size. The number of ships required depends on the shipping mix selected. The best ship mix would consist of all eight FSS ships, plus two Cape H RORO ships.



The Planning Orders only provide berthing for two FSS-sized vessels (container berth 1-2). The other berths in the Plan berth could be added to meet the requirements to berth three FSS-sized vessels simultaneously.

UNIT MOVEMENT REQUIREMENTS
MECHANIZED DIVISION

Loading Condition/ Sample Ship Mix	Vessel Types			
	FSS (RORO/Comb)	Cape H (RORO/Comb)	C3/C4 (Breakbulk)	C6/C7/C8 (Container)
Minimum Containerization:				
All FSS*	8.00	1.90		
FSS and Cape H	6.64	3.00		
All Breakbulk			37.70	
Maximum Containerization:				
FSS and Container	7.90			2.00
FSS, Cape H, and Container	7.90			2.00
Breakbulk and Container			29.58	2.00

*Only eight FSS vessels are currently available. Unit shipping requirements exceed the capacity of these eight vessels. Other vessels types are required to makeup the shortfall (Cape H or upcoming LMSR).

Legend:
RORO - roll on/roll off
FSS - fast sealift ship

Source: MTMCTEA report OA 90-4f-22, Deployment Planning Guide. Aug 91.

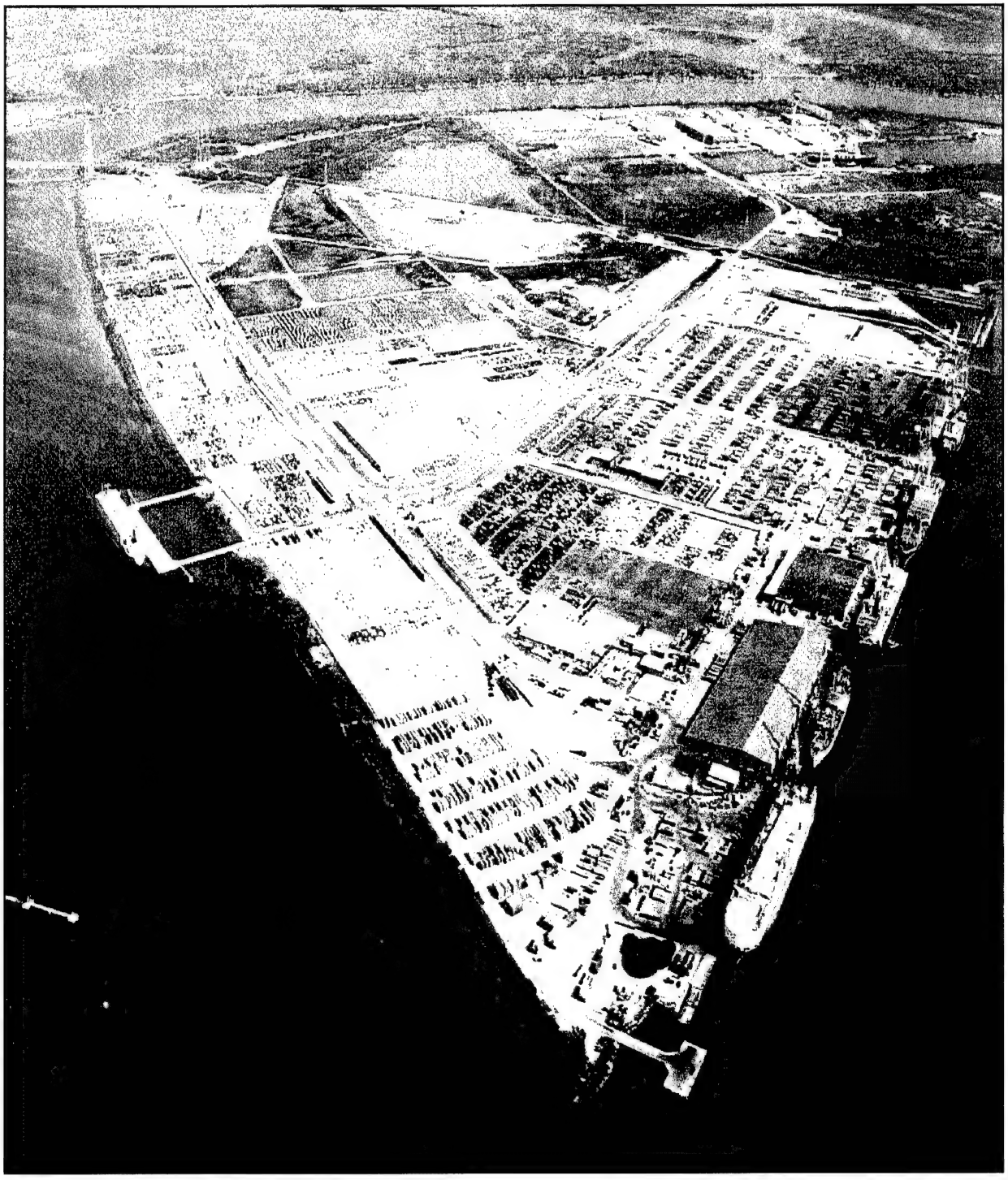
SUMMARY

The Planning Orders provide enough staging area, but not enough berthing to support the deployment of a notional mechanized infantry division. An additional container berth could be added to the Planning Orders to satisfy the requirement.

RECOMMENDATION

We recommend revising the Planning Orders to include an additional FSS-sized berth. The terminal's three fixed rail end ramps and two additional portable ramps must be available to support the rail offloading equipment.

PORT OF JACKSONVILLE, FL



I. GENERAL DATA

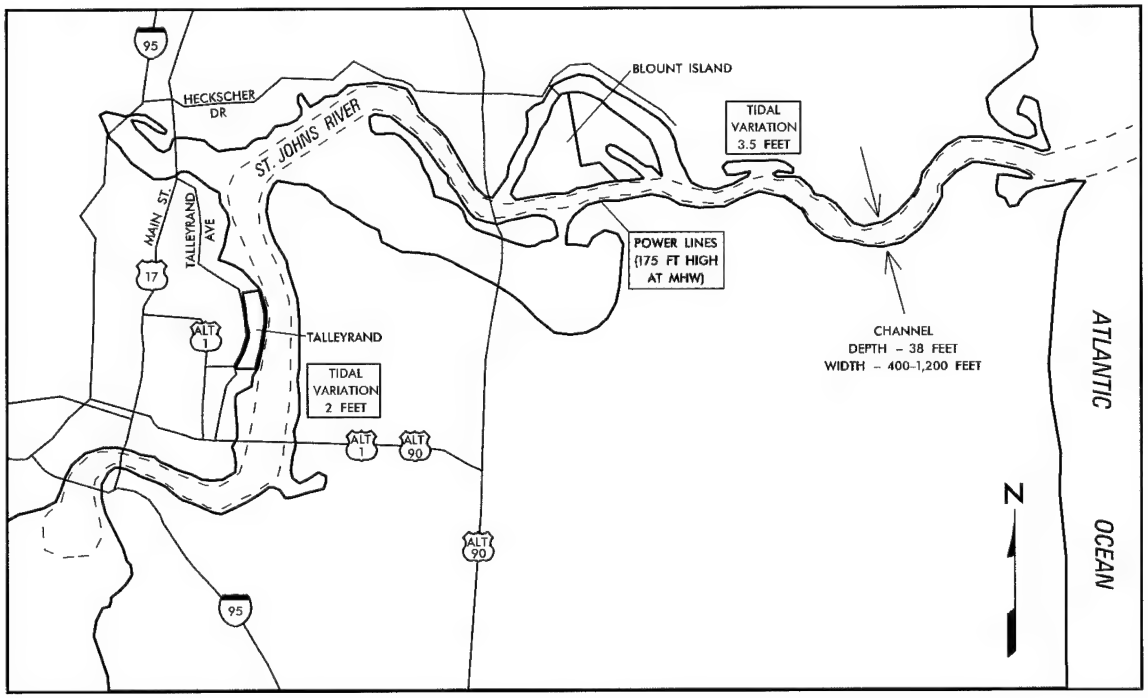
TRANSPORTATION ACCESS

Water

The St. Johns River provides access to the Port of Jacksonville terminals through the Fort George Inlet. The port consists of two main facilities: Blount Island and Talleyrand. Channel depths are 38 feet deep at mean low water (MLW) and range from 550 feet to 1,200 feet wide. Although there are no turning basins, there is sufficient space for vessels to turn in the channel near the terminals. The Talleyrand Terminal is 21 miles from the Atlantic Ocean and the Blount Island Marine Terminal is only 9 miles from open water.

Vessels awaiting entrance to the St. Johns River can anchor north-northeastward of the river entrance jetties in water ranging from 36-50 feet MLW. Also, other anchorages are available near the Talleyrand Terminal. The mean tidal range in the St. Johns River varies from 2 feet at the Talleyrand Terminal to 3.5 feet at the Blount Island Marine Terminal.

There are no bridges on the way to the terminals, but there are some overhead power lines near Blount Island that have a 175-foot vertical clearance at Mean High Water (MHW). These power lines should not cause problems when entering the port.



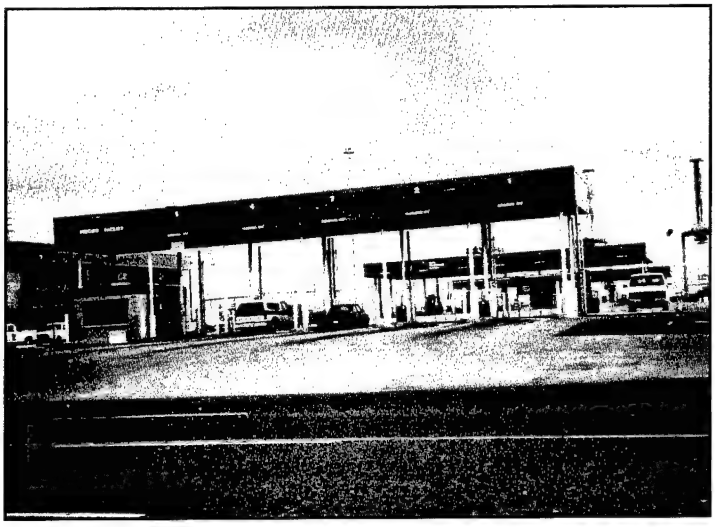
Water Access

Highway

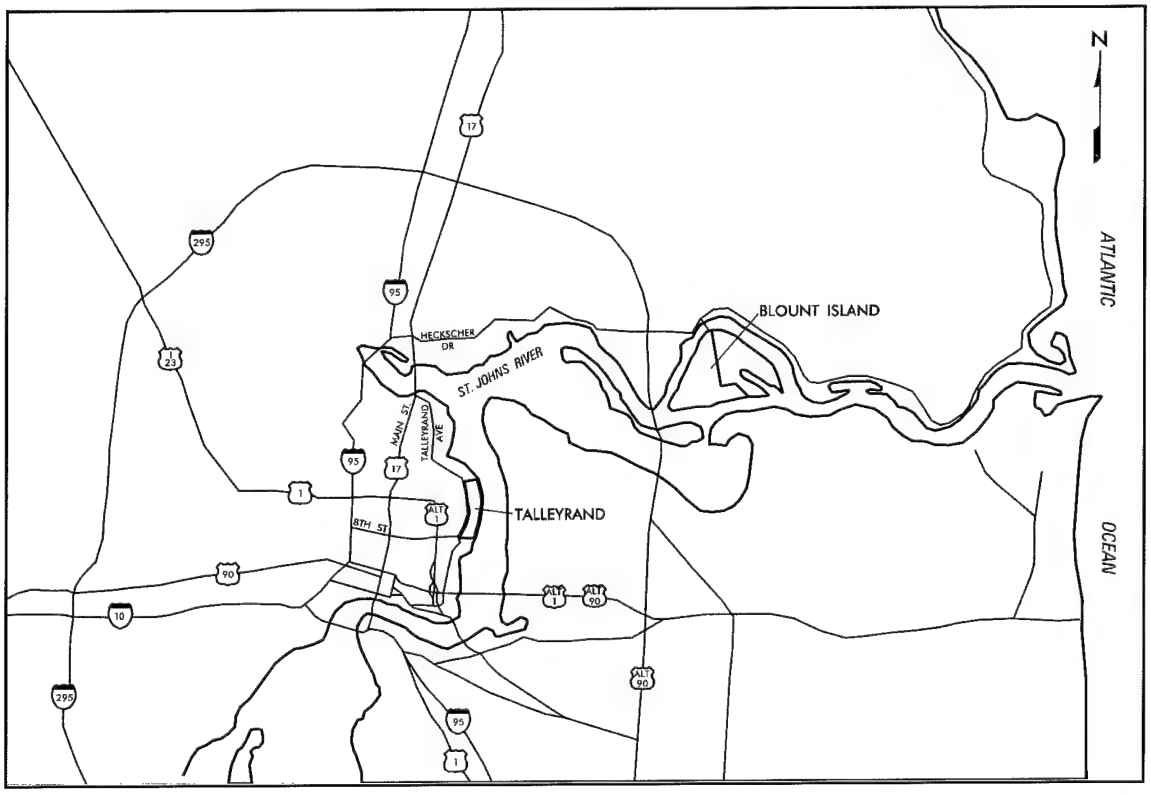
The Port of Jacksonville is within 350 miles of Miami, Atlanta, and the Orlando/Tampa/St. Petersburg area. Interstate Route 10 (I-10) from the west and Interstate Route 95 (I-95) and US Route 17 (US 17) from the north and south provide access to the Port of Jacksonville.

The berths at the Blount Island Marine Terminal, which is 2 miles off Interstate Route 295 (I-295), are accessed by Heckscher Drive.

The Talleyrand Terminal, which is only 3 miles from I-95, is accessible by Route 1 to Eighth Street and then turning onto Talleyrand Avenue. The main gates to the terminal are off Talleyrand Avenue.



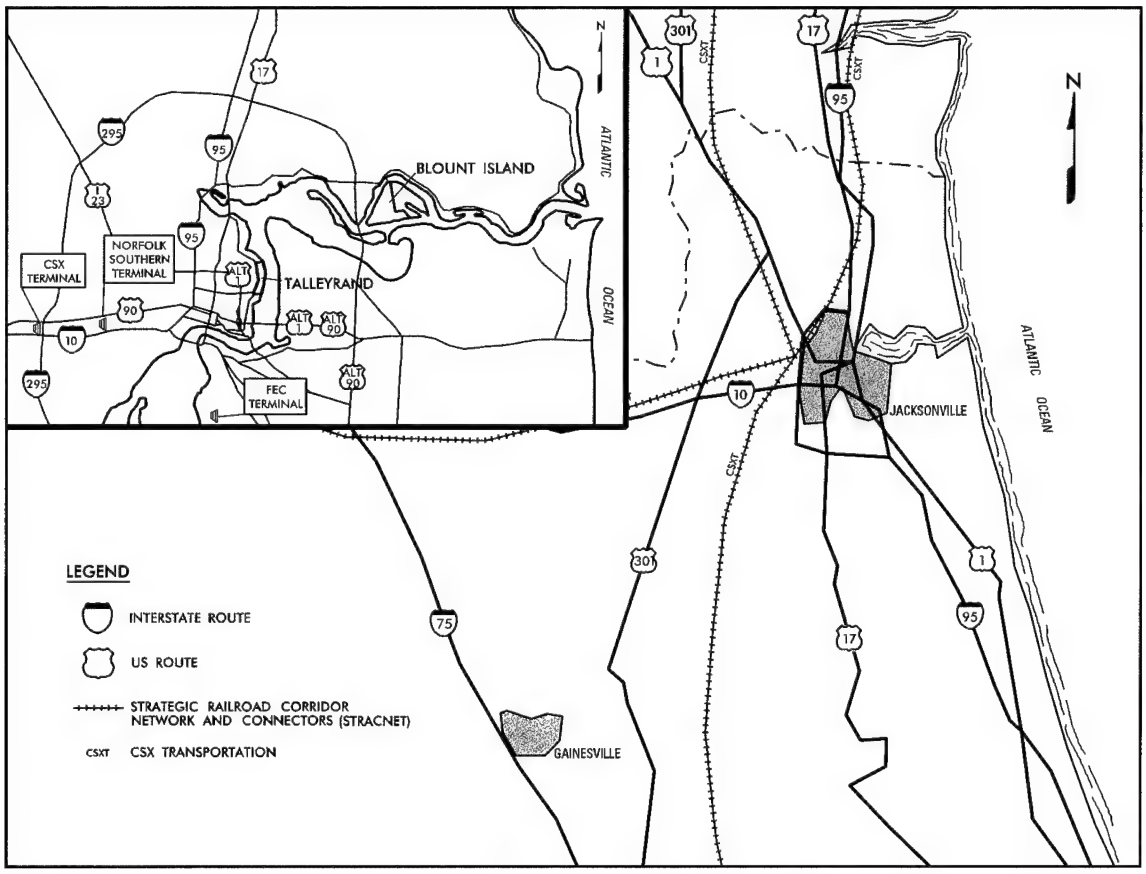
Gate to Blount Island



Highway Access

Rail

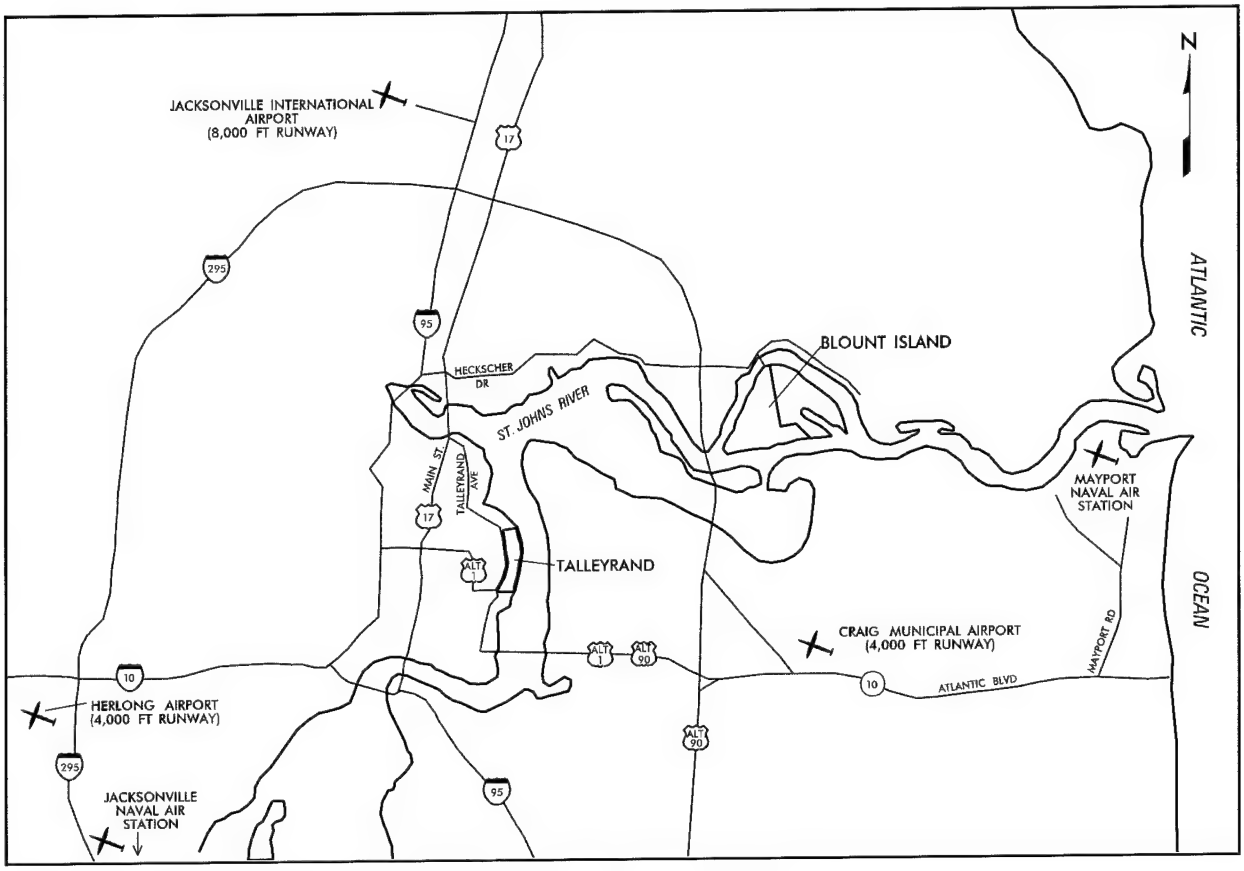
The three major rail companies that serve the Jacksonville area are: Seaboard System Rail (CSX Transportation, Inc.), Florida East Coast Railway, and Norfolk Southern Corporation. These three rail companies offer 32 trains a day to and from Jacksonville. The JAXPORT Terminal Railroad performs switching. Access to the terminals is provided by CSX (one track). Storage railyards include the intermodal facility on Blount Island, CSX Terminal, Norfolk Southern Terminal, and Florida East Coast Terminal.



Rail Access

Airports

Several airports of various sizes and capabilities are within the Jacksonville area. The largest commercial airports are Jacksonville International, Craig Municipal, and Herlong. There are also military airfields which include Mayport Naval Air Station and Jacksonville Naval Air Station.



Air Access

PORT FACILITIES

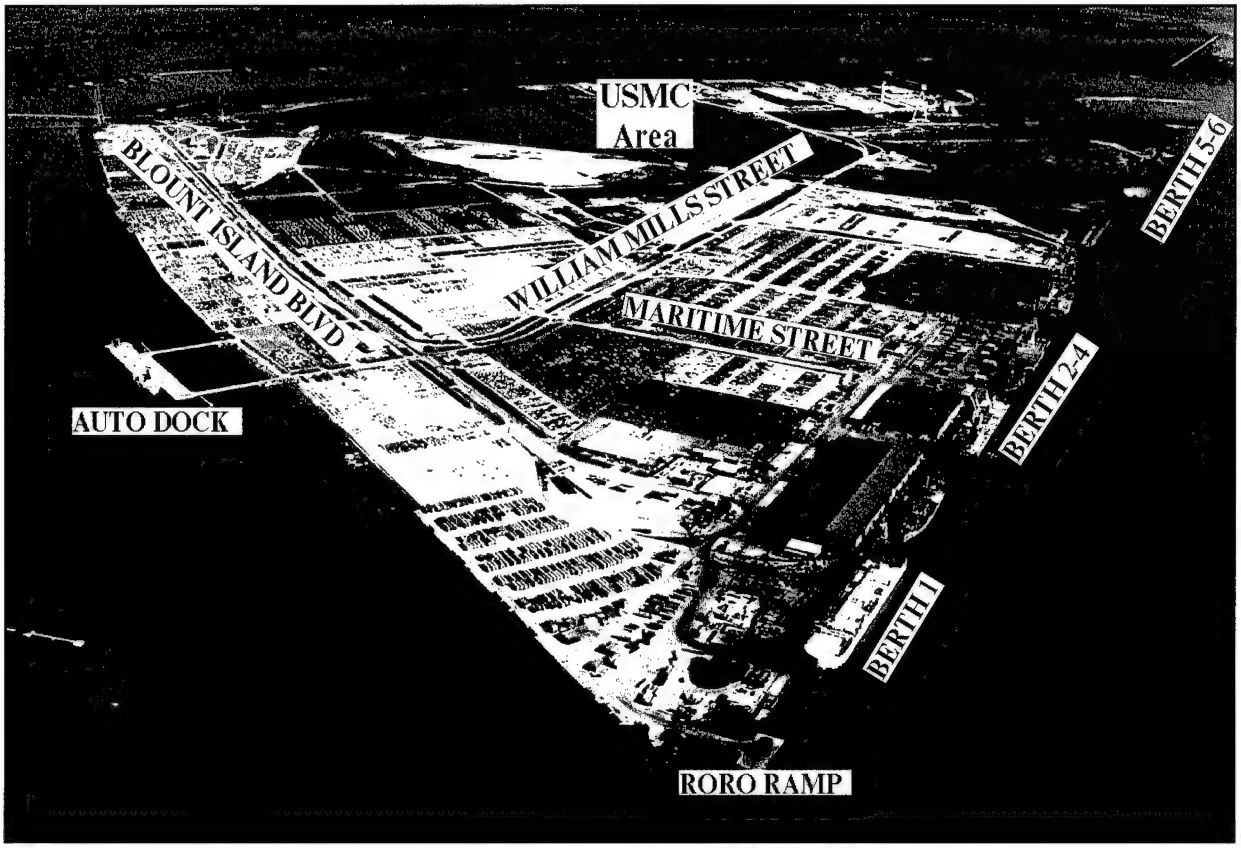
Berthing

This report covers two areas of the port. Each of these areas is considered a terminal, although each may involve several shipping lines. They are Blount Island and Talleyrand Terminals. These terminals are primarily container and auto import-export facilities. The Blount Island Marine Terminal has two RORO berths for loading and unloading automobiles.

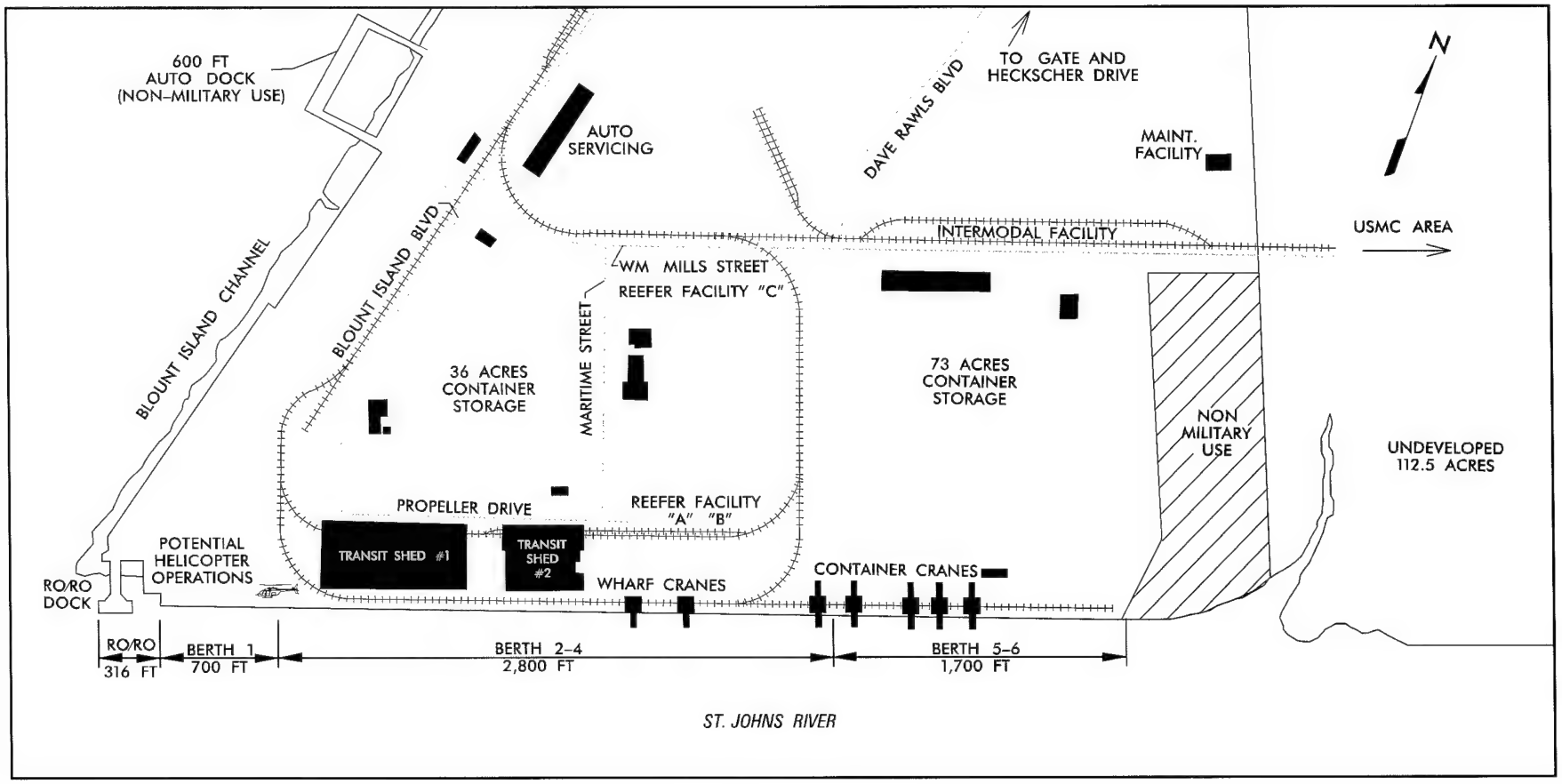
BERTHING CHARACTERISTICS OF BLOUNT ISLAND MARINE TERMINAL

Characteristics	Berths		
	1-2	2-4	5-6
Length (ft)	700	2,800	1,700
Depth alongside at MLW (ft)	38	38	38
Deck strength (psf)	800	800	800
Apron width (ft)	66	80	Open
Apron height above MLW (ft)	7	9	9
Number of container cranes	0	4	1
Number of wharf cranes	1	1	0
Apron lighting	Yes	Yes	Yes
Straignt-stern RORO facilities	Yes	No	No
Apron length served by rail (ft)	700	2,800	1,000

Below are land use maps and aerial views of the terminals. Also included are tables identifying berth characteristics.

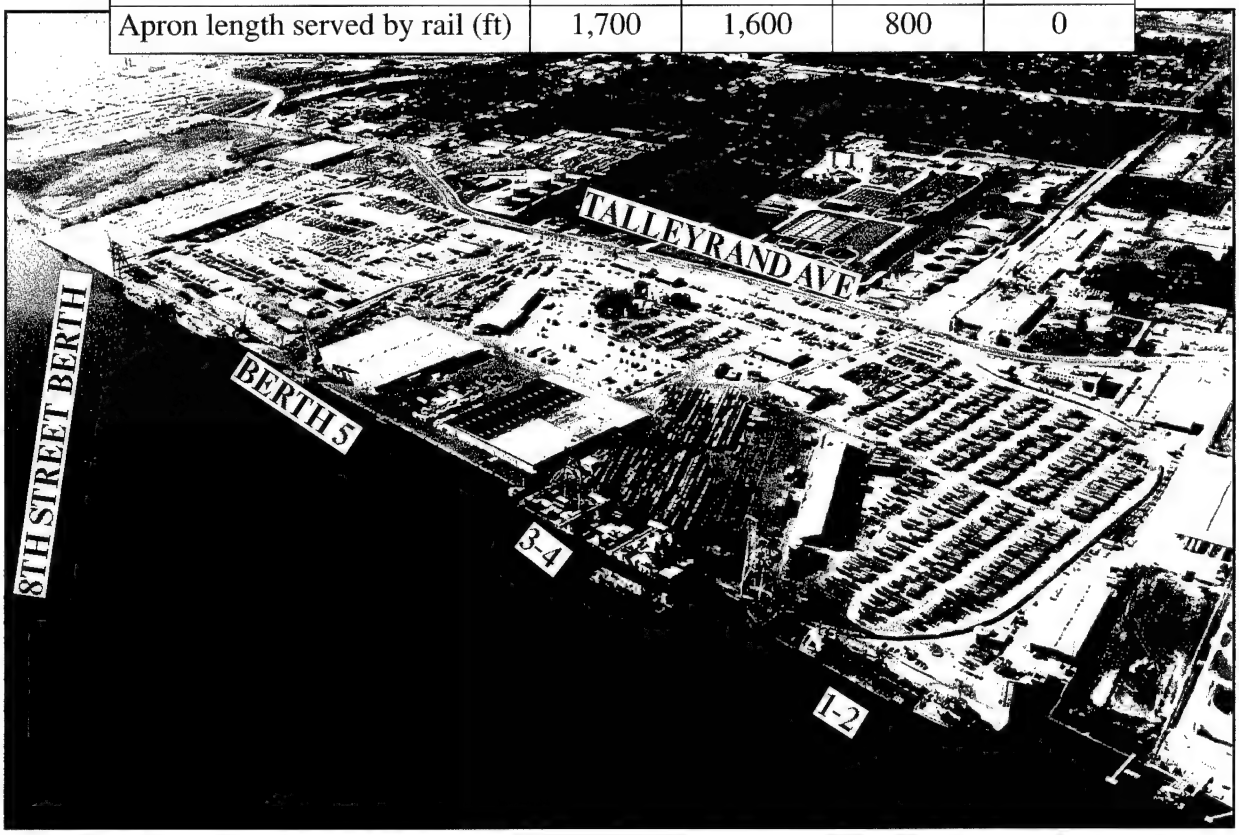


Blount Island Terminal
(Northeastward view)

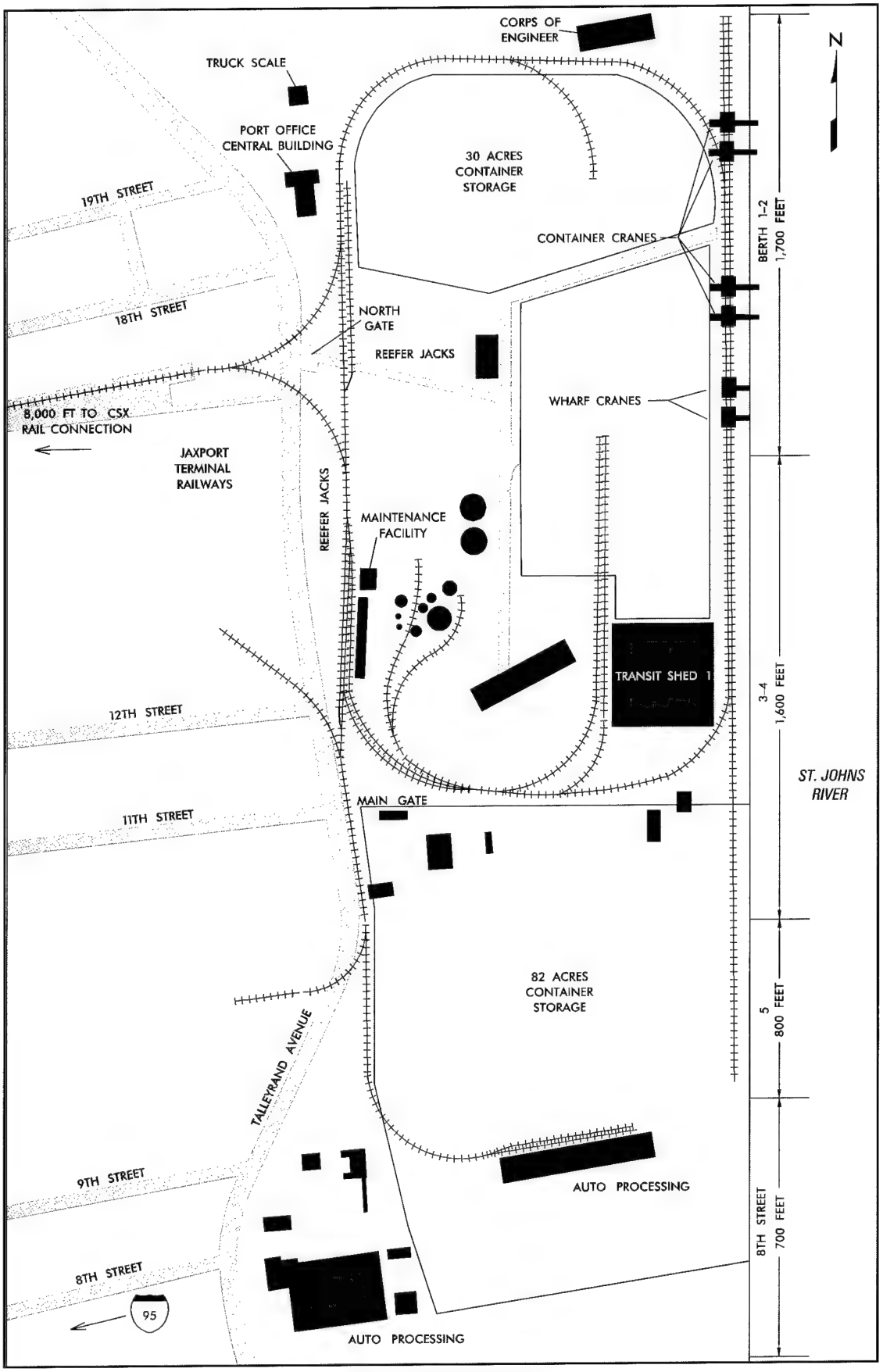


Blount Island Terminal

BERTHING CHARACTERISTICS OF TALLEYRAND TERMINAL				
Characteristics	**Berths**			
	1-2	**3-4**	**5**	**8th Street**
Length (ft)	1,700	1,600	800	700
Depth alongside at MLW (ft)	38	38	38	38
Deck strength (psf)	800	800	800	1,000
Apron width (ft)	80	Open	Open	Open
Apron height above MLW (ft)	9	9	7	9
Number of container cranes	2	2	0	0
Number of wharf cranes	0	2	0	0
Apron lighting	Yes	Yes	Yes	Yes
Straignt-stern RORO facilities	No	No	No	No
Apron length served by rail (ft)	1,700	1,600	800	0



Talleyrand Terminal (Southwestward view)

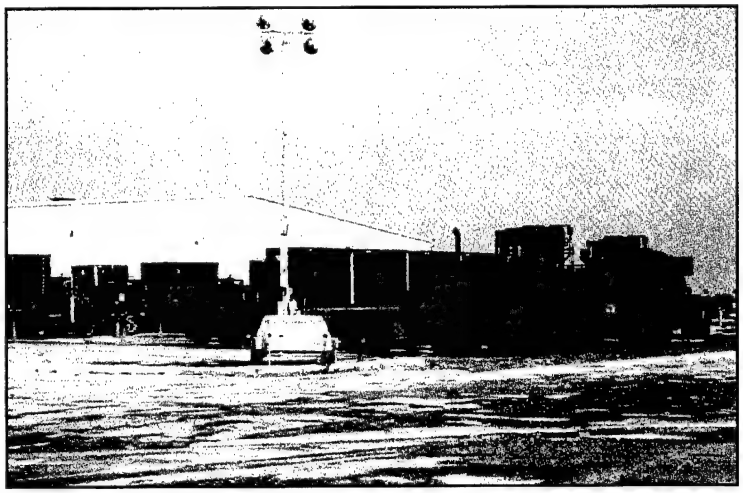


Talleyrand Terminal

Staging

Open Staging. Blount Island Marine Terminal has about 400 acres of paved staging. Open staging is used mostly for containers and import vehicles.

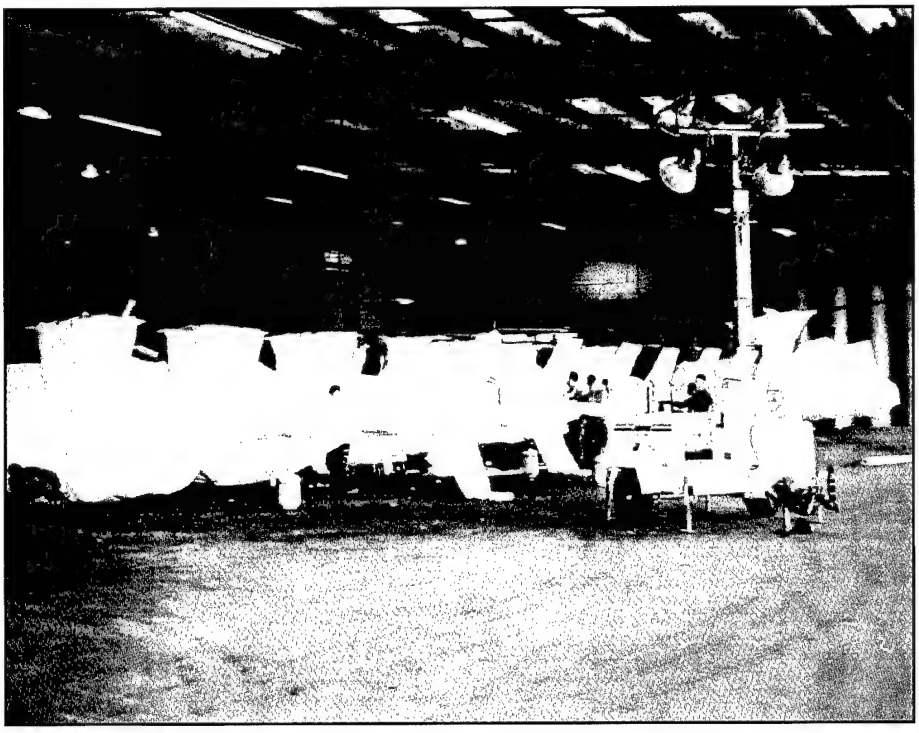
The Talleyrand Terminal has a total of 173 acres of paved open staging. Berths 1 through 5 at Talleyrand have 91 acres, 11th Street has 28 acres, and 8th Street has 54 acres.



Helicopter landing and staging is available at berth 1 of the Blount Island Terminal and near berth 5 of the Talleyrand Terminal. Craig Air Field can also receive and stage helicopters.

Open Staging at Blount Island

Covered Staging.
The Blount Island Marine Terminal has about 360,000 square feet of warehouse space. The Talleyrand Terminal has 120,000 square feet of warehouse space and an additional 40,000 square feet of refrigerated warehousing.

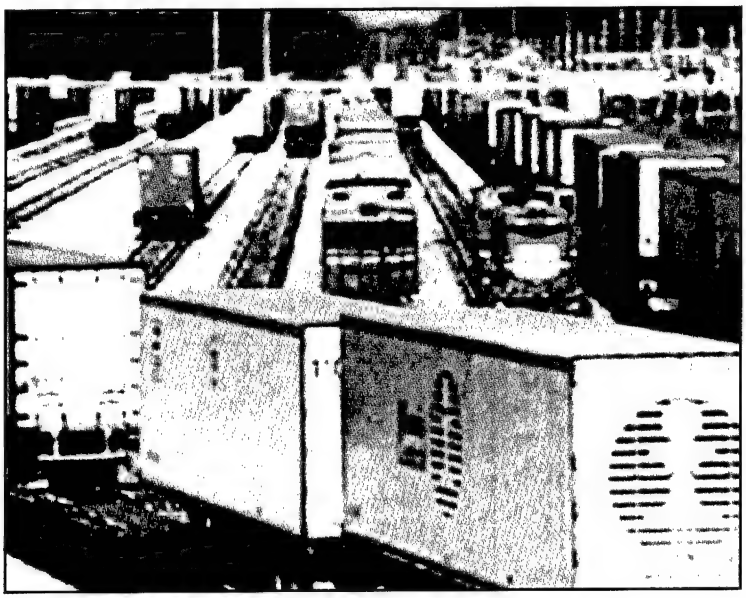


Helicopter Shrink-wrapping

Rail

At both the Blount Island and the Talleyrand Terminals, rail trackage links the railyards to the port's apron tracks, transit sheds, and storage tracks.

Talleyrand has a rail capacity of 150 cars. CSX operates a railyard that can store an additional 215 railcars and is less than 1,000 feet from the terminal's gate. Blount Island Marine Terminal can hold 250 89-foot railcars at once. There is an 11.6 acre intermodal rail facility north of berth 6.

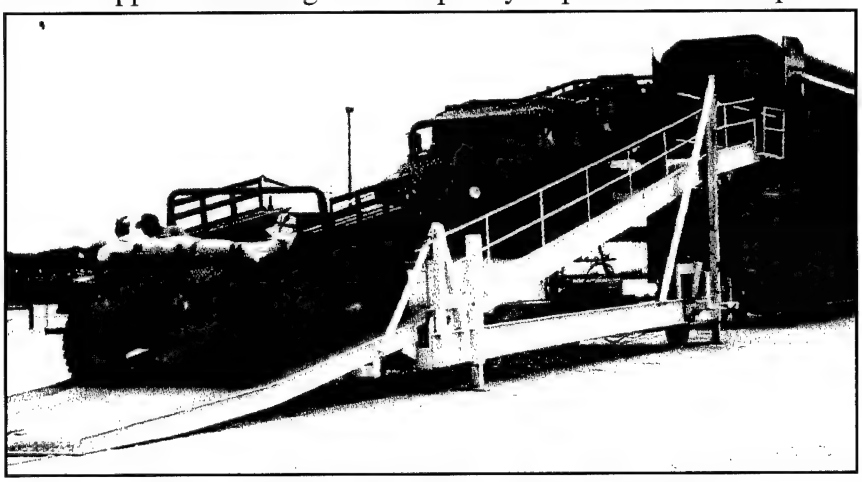


CSX Railyard

Norfolk Southern Train from Chicago

Unloading/loading Positions

Ramps. The Blount Island Marine Terminal has one light-duty rail end ramp, one heavy-duty steel ramp, and at least one bilevel ramp. Vehicles can also offload at two fixed rail end ramps at the adjacent Marine Corps facility, at the east end of the island. There are numerous locations that could support offloading with temporary or portable end ramps.



Bilevel Railcar Operations at Blount Island

Docks. Transit shed 1 at Talleyrand Terminal has six loading positions for commercial trailers. Van unloading docks are available north of the two transit sheds on Blount Island.

Marshaling Areas

Marshaling areas are available within the port area. There are some undeveloped areas in the Talleyrand Terminal. Blount Island has over 100 grass-covered acres that can support marshaling.

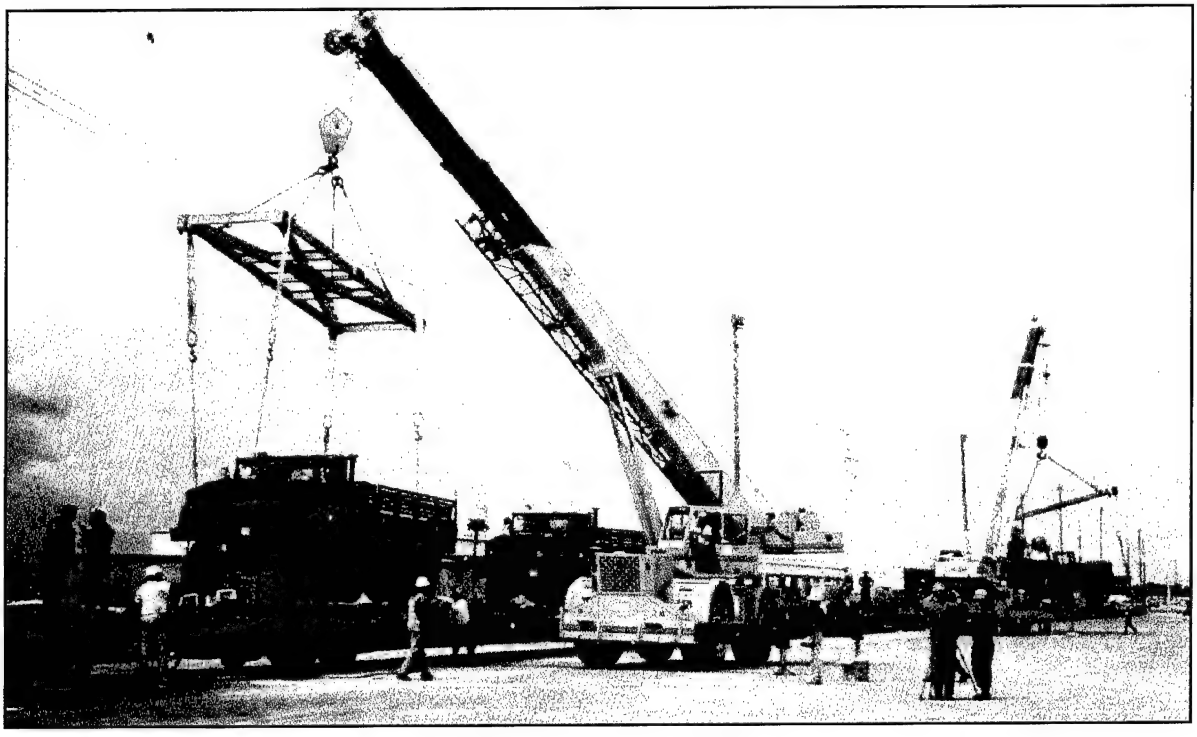
Grass-covered area at Blount Island

MATERIAL HANDLING EQUIPMENT (MHE)

The table below lists the MHE at each of the two terminals. Local stevedore contractors can supply additional MHE.

Type	Capacity (STON)	Blount Island	Talleyrand
Container Stackers	35	2	
Container Stackers	40		3
Container Stackers	45	2	

Side-loader at CSX Sea-Land Intermodal Terminal



Mobile Cranes at Blount Island

INTERMODAL FACILITIES

Blount Island has an 11.6 acre intermodal rail facility north of berth 6. Talleyrand has small intermodal facilities in different areas.

The locations of offsite intermodal facilities are shown on the rail access map earlier in this report. Norfolk Southern has an Intermodal Container Transfer Facility (ICTF) close to the Talleyrand Terminal and I-10. The ICTF has tracks for 60 railcars, three top-lift cranes, and 600 parking spaces.

CSX operates the Duval Terminal, 15 miles from Talleyrand and 18 miles from Blount Island. The Duval Terminal has two loading tracks with a capacity for 80 railcars. It also has seven supporting tracks that can store 200 flatcars. The terminal has three sideloaders. There are 450 paved and 900 unpaved parking spaces.

Florida East Coast Railway has an ICTF on Jacksonville's south side near I-95 and I-295. This facility handles trailers-on-flatcar and containers-on-flatcar cargo.

FUTURE DEVELOPMENT

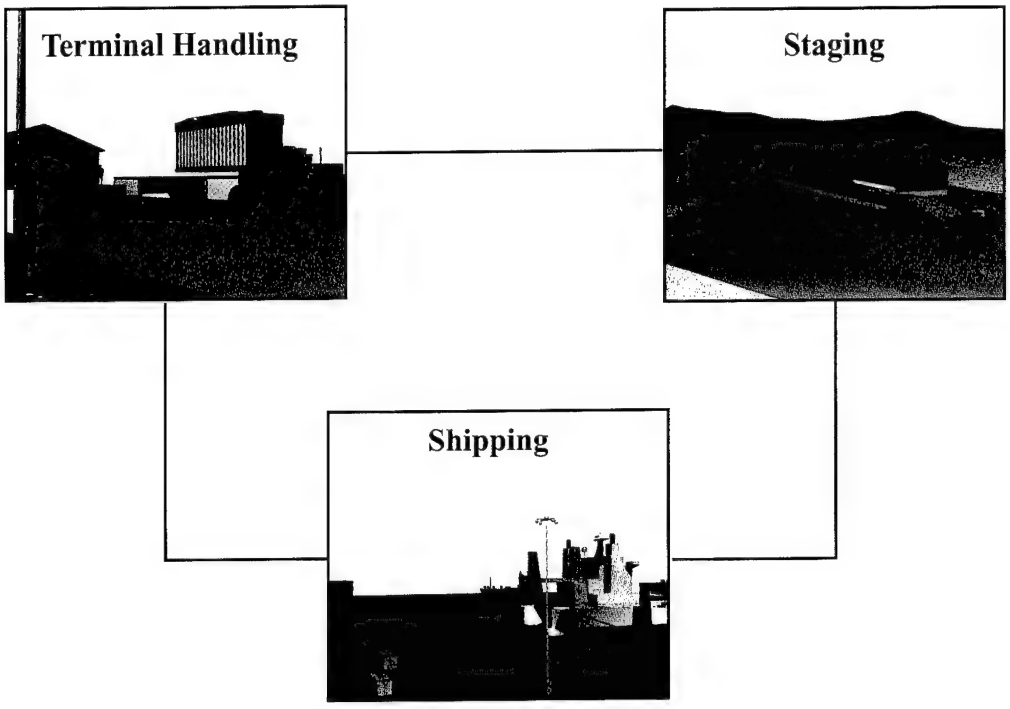
Plans are to develop the Dames Point area west of Blount Island to handle the port's breakbulk, bulk, and vehicle cargos. Talleyrand and Blount Island Terminals would then be improved for increased container operations. About 90 additional acres will be paved on Blount Island's west side for increased container staging over the next ten years. With the USMC operations, there is very little room for expansion on Blount Island's east side.

Over the next ten years, the Talleyrand Terminal will likely add container staging further inland after rerouting Talleyrand Avenue. This will more than double the paved open area of the terminal. The terminal berthage is also expected to extend about 2,000 additional feet to the east.

II. THROUGHPUT ANALYSIS

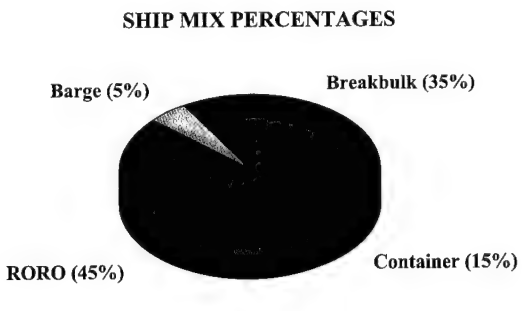
GENERAL

This section evaluates the throughput capability of the Port of Jacksonville using the port operational performance simulator (POPS) computer model. The model is based on a weak link analysis in which each subsystem is analyzed separately and then compared to find the least capable subsystem. The weakest subsystem defines the maximum throughput capability of the terminal. The model yields throughput capability values for three subsystems - shipping, staging, and terminal processing/handling - in terms of measurement tons (MTON) per day.



Terminal Throughput Subsystems

This analysis assumes a maximum of 80 percent of the port facilities can be made available at any one time. For this reason, we ran all port analyses using an 80 percent facility-use factor. Also, the ship mix is based on Desert Shield and Desert Storm statistics. We weighted the percentages to adjust for differences in cargo deadweights and expectations for future deployments.



RECEPTION/HANDLING

Highway

Blount Island Marine Terminal is reached by taking I-295 to Heckscher Drive. Eighth and 11th Streets, and Talleyrand Avenue provide access to the Talleyrand Terminal. Each terminal has a designated entrance for trucks. The road network in and out of the terminals, including the gate processing of vehicles, could handle about 190,000 MTON of equipment and supplies per day.

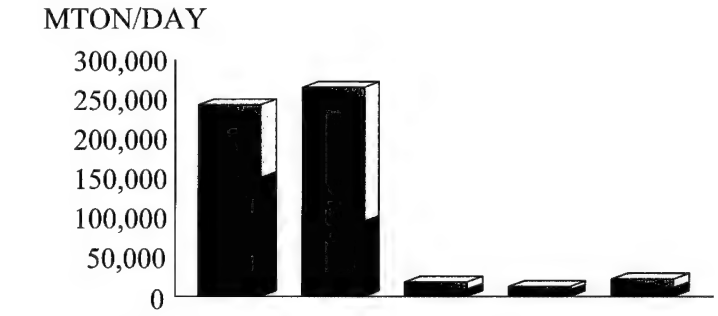
Roadable vehicles in convoys will process directly to the staging areas. Vehicles on commercial or military flatbed trailers without integral ramps will offload at portable ramps. There are no permanent truck end ramps at the port. Our analysis assumes four portable ramps, two at each terminal. These ramps could offload over 19,000 MTON from flatbed trailers per day.

Supplies in van semitrailers will proceed to the 32 van-handling positions. These docks can offload over 14,000 MTON of van semitrailer-shipped material per day. This report assumes there are four rented container handlers for chassis operations, two at each terminal. These container handlers can offload about 23,000 MTON of cargo from their chassis per day.

Truck Handling Facilities

Terminal	Portable Truck End Ramps	Van Handling Positions	Container Handlers
Blount Island	2	20	2
Talleyrand	2	12	2

HIGHWAY RECEPTION/HANDLING CAPABILITY



SUBSYSTEMS	HIGHWAY	GATES	END-RAMPS	DOCKS	CONTAINERS
BLOUNT ISLAND	150,000	95,000	9,600	9,000	12,000
TALLEYRAND	92,000	170,000	9,600	5,400	11,000

Rail

Rail reception at the port is adequate, with three major railroad companies accessing the Jacksonville area.

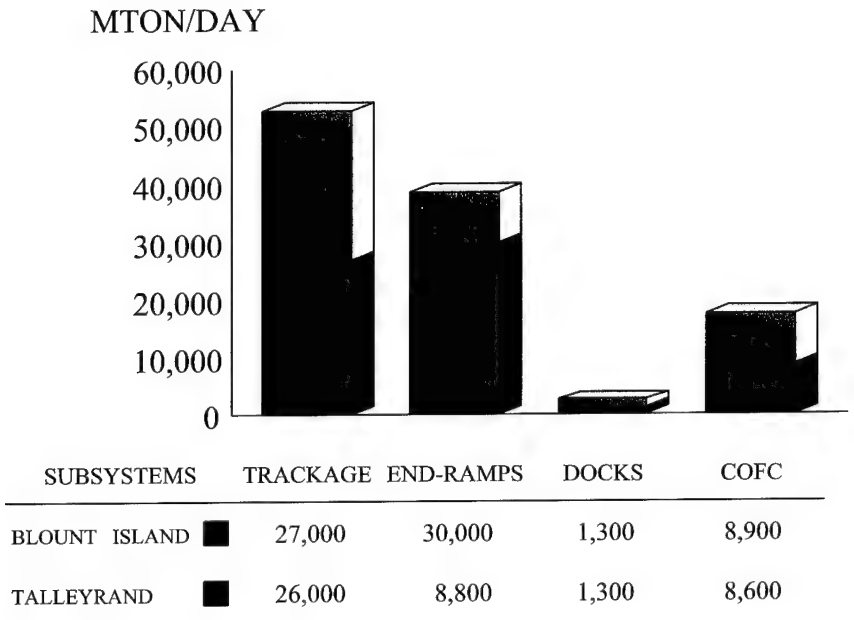
This analysis assumes both of the fixed ramps in the USMC area east of the Blount Island Terminal and two portable ramps will be available. The total length of track assumed for offloading operations is 4,900 feet. Most of this is in the USMC area. We also assume four container handlers or mobile cranes are available for COFC operations.

Boxcars could offload at the transit sheds where about 24 boxcar handling positions are available.

Rail Facilities

Terminal	Trains Per Day	Train Length (railcars)	Rail End Ramps	Boxcar Docks	Container Handlers
Blount Island	4	60	2 fixed 1 portable	12	2
Talleyrand	4	60	1 portable	12	2

RAIL RECEPTION/HANDLING CAPABILITY



STAGING

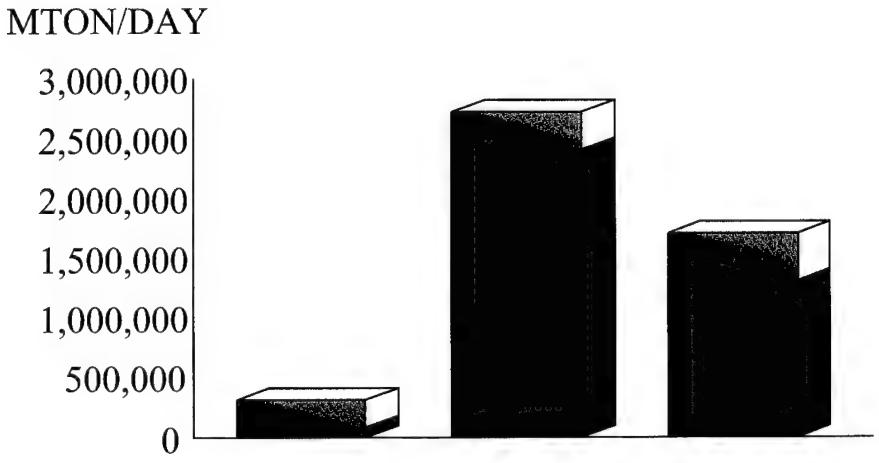
All together, the port has more than 700 acres of open staging. The two terminals have over 520,000 square feet of covered storage.

The port can perform operations on RORO, container, or breakbulk ships. The cargo mix depends on the anticipated vessel type. For example, cargo will be containerized if a containership is planned. The chart below provides the staging capability for the cargo for each of these vessel types. If a combination ship is expected, then a portion of each involved capability should be assumed.

Staging Areas

Terminal	Open Staging (Acres)	Covered Staging (SQ FT)
Blount Island	566	360,000
Talleyrand	173	160,000

OPEN STAGING CAPABILITY



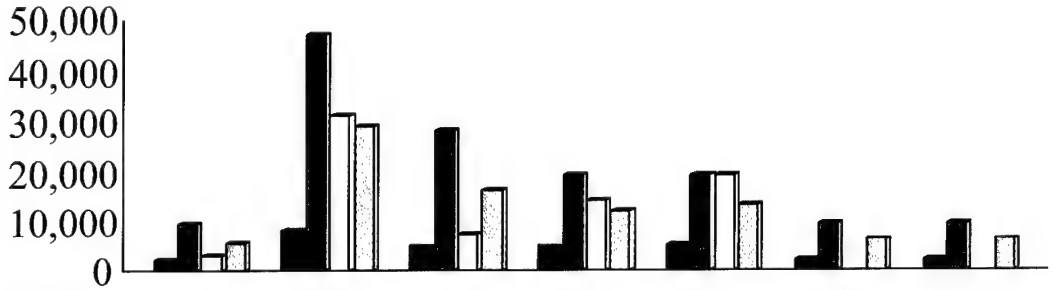
VESSEL TYPE	RORO	CONTAINERS	BREAKBULK
BLOUNT ISLAND	75,000	2,400,000	1,300,000
TALLEYRAND	230,000	320,000	400,000

SHIPPING

Throughputs for each berth are shown below. They are based on various factors, including MHE used, loading, operational, and berth usage rates included in Appendix A.

BERTH THROUGHPUT CAPABILITY

MTON/DAY



BERTH	B-1	B2-4	B5-6	T1-2	T3-4	T5	8TH ST
BREAKBULK	1,900	8,100	4,800	4,800	5,000	1,900	1,900
RORO	9,400	47,000	28,000	19,000	19,000	9,400	9,400
CONTAINER	2,700	31,000	7,000	14,000	19,000	0	0
MIXED	5,400	29,000	16,000	12,000	13,000	6,100	6,100

B = Blount Island
T = Talleyrand

CONVERSION FACTORS	
Breakbulk	.4 STON per MTON
RORO	.25 STON per MTON
Containers	.4 STON per MTON

The type of ship preferred at each berth is based on the methodology described in Appendix B. The evaluation is based on a snapshot view of the current physical characteristics of the berths and the MHE available. The evaluation to the right gives no considerations for enhancements, such as equipment. The lower the number for a berth, the better the berth is suitable for the loading operation.

Berths 1 through 6 at Blount Island can support FSS and LMSR operations. During Desert Shield/Storm these berths handled four FSS vessels. This is mostly due to the open apron.

PREFERENCE BERTH SELECTION

Berth	BB	RORO	CNTR
Talleyrand Terminal			
1-2	3	1	1
3-4	1	1	2
5	4	3	3
8th Street	2	4	-
Blount Island Marine Terminal			
1	2	2	3
2-4	1	1	2
5-6	3	3	1

NOTE: Berths marked with a "-" are not recommended for these operations.

The Talleyrand Terminal can support FSS and LMSR operations at berths 3 and 4.

SUMMARY OF BERTHING CAPABILITIES OF BLOUNT ISLAND AND TALLERAND TERMINALS

Vessel	Berth						
	B = Blount Island			T = Talleyrand			
	B1	B2-4	B5-6	T1-2	T3-4	T5	T8th Street
Breakbulk							
C3-S-33a	1	5	3	3	3	1	1
C3-S-37c	1	5	3	3	3	1	1
C3-S-37d	1	5	3	3	3	1	1
C3-S-38a	1	5	3	3	3	1	1
C4-S-1a	1	4	2	2	2	1	1
C4-S-1qb and 1u	1	4	2	2	2	1	1
C4-S-58a	1	4	2	2	2	1	1
C4-S-65a	1	4	2	2	2	1	1
C4-S-66a	1	4	2	2	2	1	1
C4-S-69b	1	4	2	2	2	1	1
Seatrain							
GA and PR-class	1	4	2	2	2	1	1
Barge							
LASH C8-S-81b	c	3	2	2	1	c	c
LASH C9-S-81d	c	3	1	1	1	c	c
LASH lighter	5	20	12	12	11	5	5
SEABEE C8-S-82a	a,c,g	a,g	a,g	a,g	a,g	a,c,g	a,c,g
SEABEE barge	3	14	7	7	7	4	3
RORO							
Comet	l,i	5,d,i	3,d,i	d,i,j	d,i,j	1,d,i	d,i,j
C7-S-95a/Maine-class	c	3	2	2	2	1	c
Ponce-classb,h	b,h	b,h	h	b,h	h	h	h
Great Land-class	b,c,h	b,h	h	b,h	h	h	c,h
Cygnus/Pilot-class	1	4	2	2	2	1	1
Meteor	l,i	d,i,j	d,i,j	d,i,j	d,i,j	d,i,j	d,i,j
AmEagle/Condor	l,i	4,i	2,i	i,j	i,j	i,j	i,j
MV Ambassador	k,m	d	d	d	d	d	d
FSS-class	(1)	(2)	1	1,n	1	(1)	c
Cape D-class	l,i	3,i	2,i	i,j	i,j	i,j	i,j
Cape H-class	(1)	3	2	2	2	1	(1)
LMSR	(1)	2	1	1	1	(1)	(1)
Container							
C6-S-lw	1,e	4	2	2	2	1,e	1,e
C7-S-68e	c,e	3	2	2	2	1,e	c,e
C8-S-85c	c,e	3	1	1	1	c,e	c,e
Combination							
C5-S-78a	1,e	4	2	2	2	1,e	1,e
C5-S-37e	1,e	4	2	2	2	1,e	1,e

a=vessel draft limited to berth depth
b=inadequate apron width
c=inadequate berth length
d=no straight stern-ramp facilities
e=no container-handling equipment
f=shallow berth, adequate anchorage depth
g=inadequate channel depth
h=no shore-based ramps available
i=insufficient ramp clearance at low tide
j=insufficient ramp clearance at high tide
k=excessive ramp angle at low tide
m=excessive ramp angle at high tide
n=parallel ramp operation only
o=too narrow apron for side-ramp

Notes: Ramp clearance and ramp angle based on maximum vessel draft
( ) indicates vessels assigned by analyst

III. APPLICATION

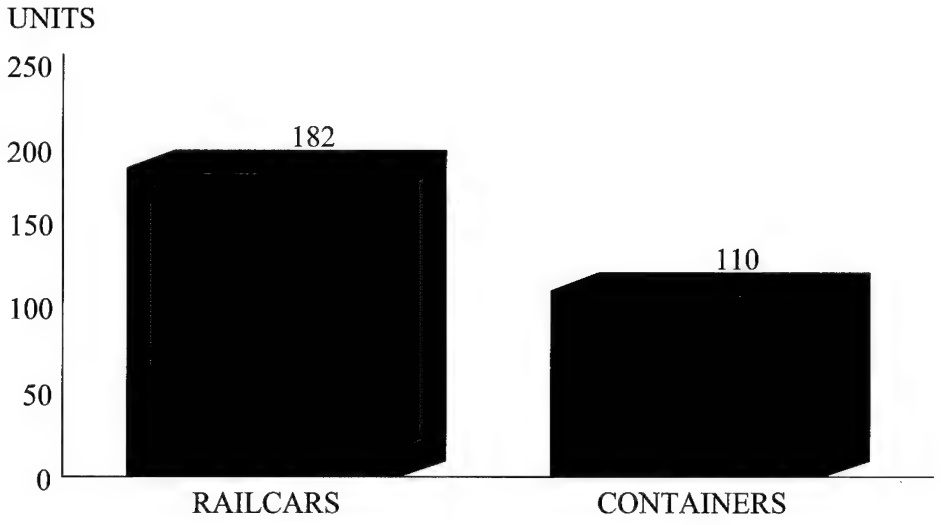
GENERAL

This section of the report will evaluate the port's throughput capability for deploying a notional air assault division using primarily FSS vessels. The August 1994 revision for the ***Planning Orders Digest***, issued by MARAD, provided agreements for military use of the Port of Jacksonville. These agreements have been renewed until 15 June 1996. The Planning Orders call for the use of 13 acres open staging, 3,000 feet of berthing, and adequate warehouse space at the Blount Island Terminal.

REQUIREMENTS

The likely requirement for the Port of Jacksonville is to deploy an air assault division in six days of reception and throughput. The division will likely come from Fort Campbell, Kentucky, about 627 miles from the port. The movement to the port will require 1,095 (182 per day) railcars using the all-rail option. About 110 containers would arrive per day.

DAILY REQUIREMENTS



TERMINAL INPROCESSING/HANDLING

Highway

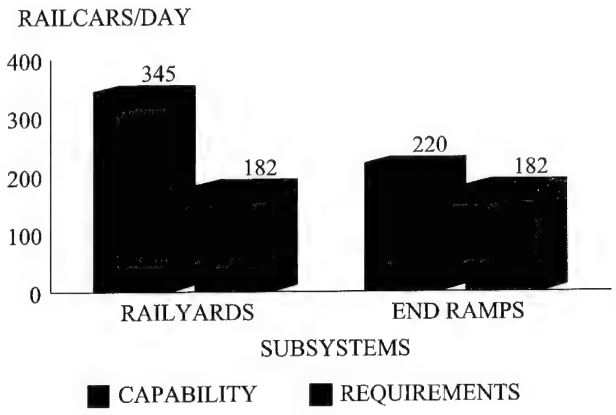
Should military vehicles arrive by convoy, they will enter the Blount Island Terminal from Heckscher Drive (Florida Route 105) over the bridge linking the island to Dames Point. Heckscher Drive intersects with several highways, including: I-95, I-295, and US 17. The road entering the terminal has four lanes. Port Support Activity personnel assist port police in receiving military vehicles at the terminal gate, and directing them to a processing area.

Rail

CSX railroad serves the Blount Island Terminal directly and switches all railcars on the island. Two other railroads, the Norfolk Southern and the Florida East Coast, have intermodal ramps located only a short distance (7 miles) from the terminal at the Imeson Industrial Park, the city's former airport.

CSX also operates the Busch switch yard with a capacity for approximately 250 cars, about 6 miles from the Blount Island Terminal. This yard alone could meet the requirement for rail reception and storage. The terminal can only receive and store about 95 railcars per day, without disrupting commercial operations.

RAIL INPROCESSING AND HANDLING CAPABILITY



The spurs at the two fixed ramps in the USMC area east of the terminal can each support offloading of about 20 railcars. This analysis will also assume one spur of the intermodal yard is available to support offloading an additional 15 railcars, with a portable ramp. Conducting four switching cycles per day at these three offloading areas would offload about 220 railcars per day. This exceeds the requirement.

Additionally, a dedicated switch engine will assure smooth efficient reception.

STAGING

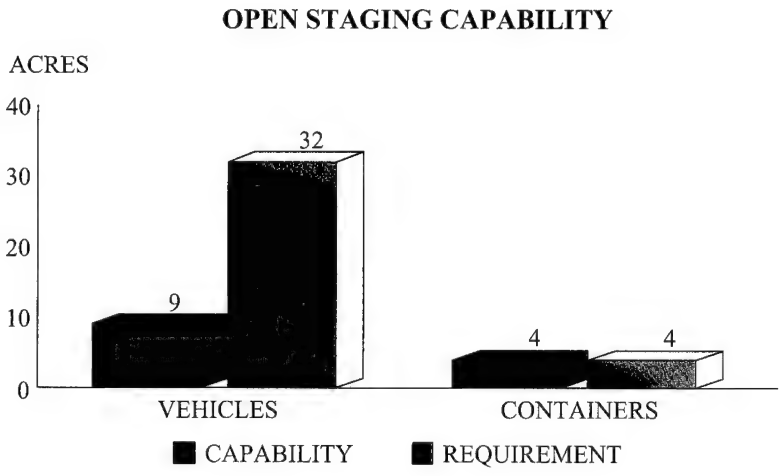
Although an FSS-load of cargo can be staged and loaded on 10 acres, 16 acres are required for sustained loading operations. Of these 16 acres, about two acres are required for the staging of the 70 containers for each FSS.

The current size of an Air Assault Division requires 6.2 FSS-sized ships to deploy. We assume 6 FSS vessels and a small notional RORO (Ambassador/Senator class) will be used. This requires the port to simultaneously perform two sustained FSS loading operations (16 acres each) at the same time as a one-time small RORO loading operation (4 acres).

This requirement of 36 acres for staging is conservative for two reasons. We assume the small RORO vessel will load in the early stages of the deployment. The staging requirement would be less if the small RORO would load with the final two FSS-sized vessels. The final two FSS loading operations are no longer sustained operations, and therefore would only require 10 acres each. We also assume the Ambassador/Senator class vessel will sail fully loaded (about 40 percent of an FSS-load). This assumption will allow the final two FSS-sized vessels to sail with less than full loads, or with a reduced stow factor.

The Planning Orders only call for 13 acres of staging. This is not enough to meet the 36-acre requirement, as shown below.

Additional staging to meet the requirement is available at the terminal. The Blount Island Terminal contains over 680 acres, of which more than 400 is open and used for staging commercial cargo. Two transit sheds provide 360,000 square feet of covered staging area. Discussions with personnel from the MTMC Cape Canaveral Outport and port operators indicate that about 75 acres are usually available. The Marine Corps' 160 acres will also likely be available. USMC operations will likely be complete before the division arrives.

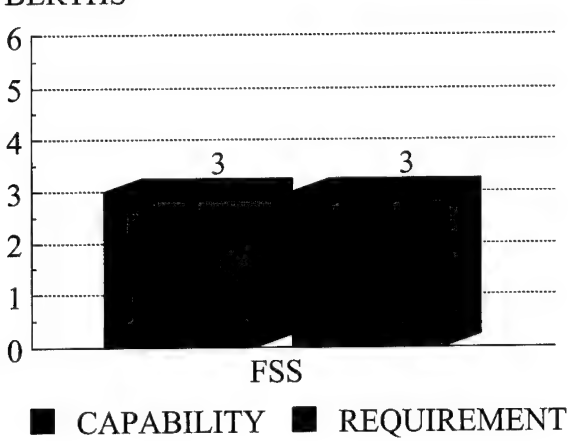


SHIPPING

The requirement is to berth three ships simultaneously, for two days. At least two of these ships are to be FSS-sized. The planning orders provide berthing for three FSS-sized vessels. This meets the requirement. The remaining four days of the deployment will only require berthing for two FSS-sized vessels.

Although this analysis assumes 6.2 FSS-sized ships can deploy the air assault division, the table below provides ship quantities for various ship types. The number of ships required depends on the shipping mix selected.

FSS SHIPPING CAPABILITY



UNIT MOVEMENT REQUIREMENTS, AIRBORNE ASSAULT DIVISION

Vessel Type	Number of Ships
All FSS	6.2
All LMSR	3.5
Notional RORO	11.85
All Breakbulk	24

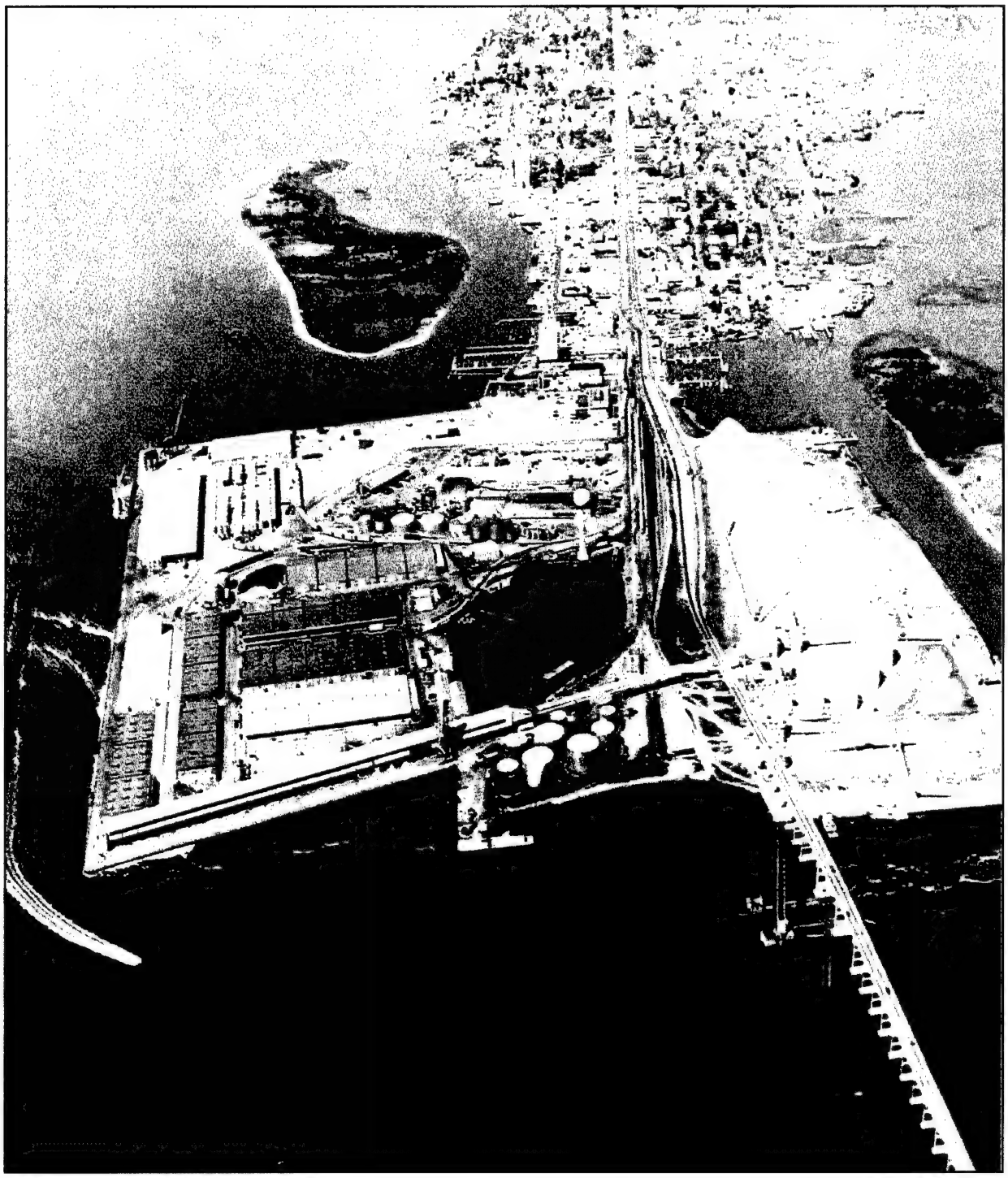
SUMMARY

The Blount Island Marine Terminal has adequate characteristics to support the deployment of an Air Assault Division. The current Planning Orders do not provide enough staging area. The 3,000 feet of berthing is sufficient to meet the requirement.

RECOMMENDATION

We recommend revising the MARAD Planning Order Digest, to include an additional 23 acres of staging, and 5,500 feet of tangential track.

PORT OF MOREHEAD CITY, NC



I. GENERAL DATA

TRANSPORTATION ACCESS

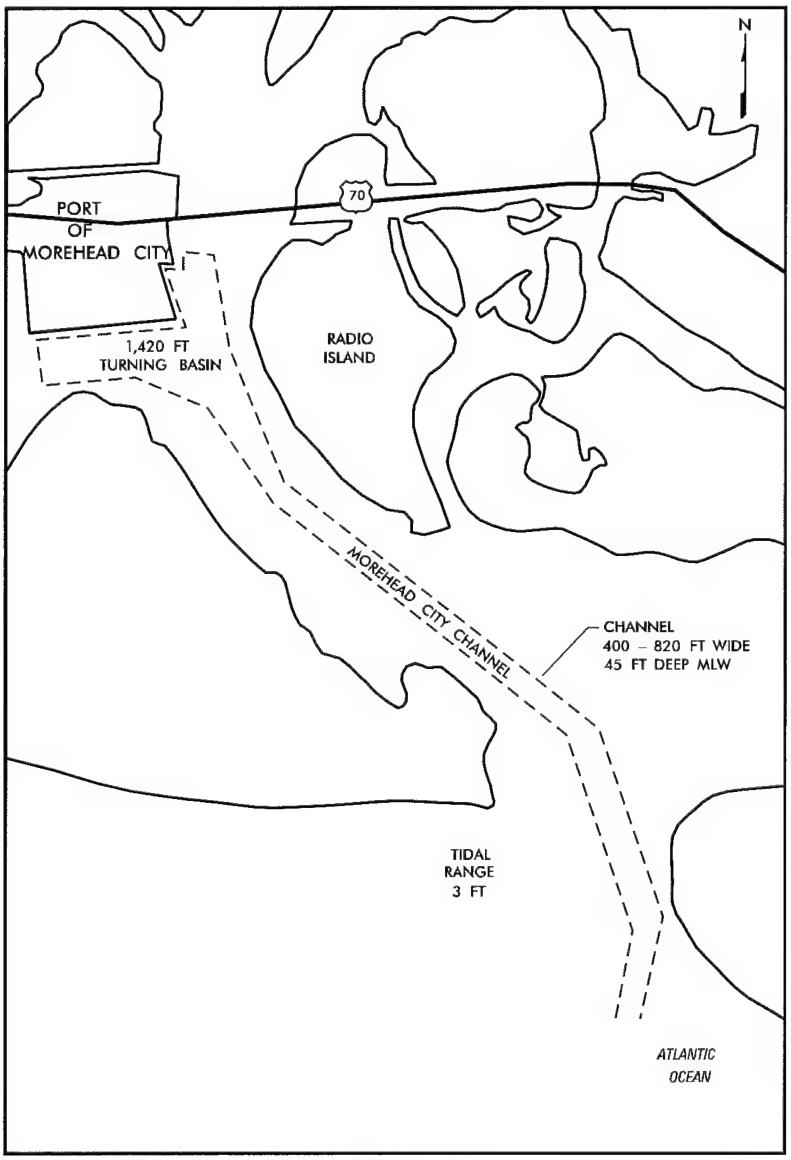
Water

The Port of Morehead City is along the Newport River and Bogue Sound. It is only 4 miles from open water. The channel that provides access to the port starts at the ocean bar channel at a depth of 47 feet deep mean low water (MLW) and is 450 feet wide. The inside channel is 45 feet deep and varies from 400 to 820 feet wide.

The mean tidal range at Morehead City is 2.9 feet.

There are no bridges on the way to the port. Ships may turn in either the east turning basin, which has a diameter of 1,420 feet at 45 feet MLW or the west turning basin off berths 7 and 8, which has a water depth of 35 feet MLW.

The port has no designated anchorage location. Vessels may wait near the sea buoy or farther east near Cape Lookout.

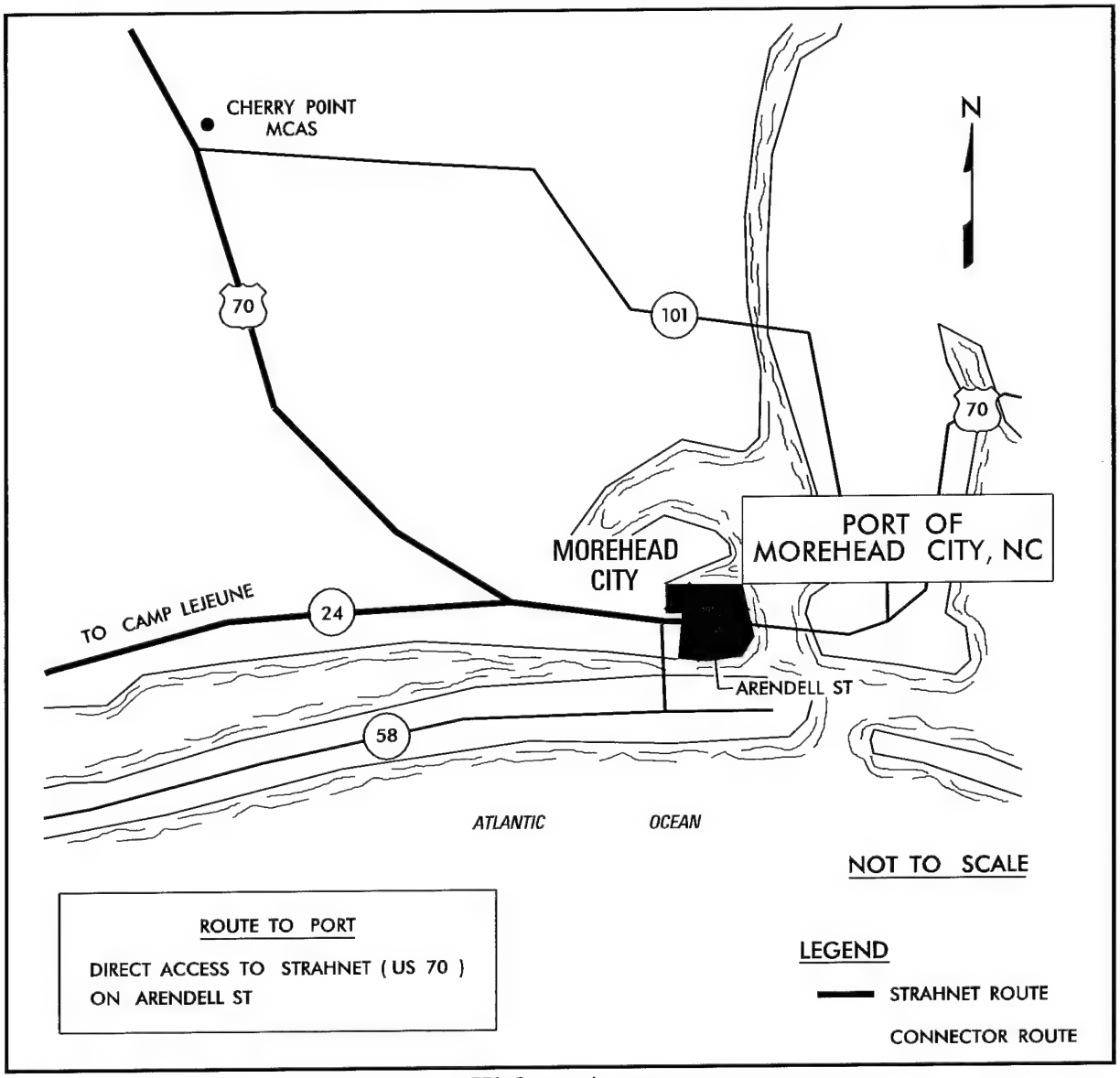


Water Access

Highway

The port lies just east of Havelock and southwest of the Outer Banks of North Carolina. Access to the port is via US Route 70 from the northwest and North Carolina Route 24 from the southwest. Just before reaching the port, North Carolina Route 24 and US 70 become Arendell Street, which then continues through Morehead City and into the port.

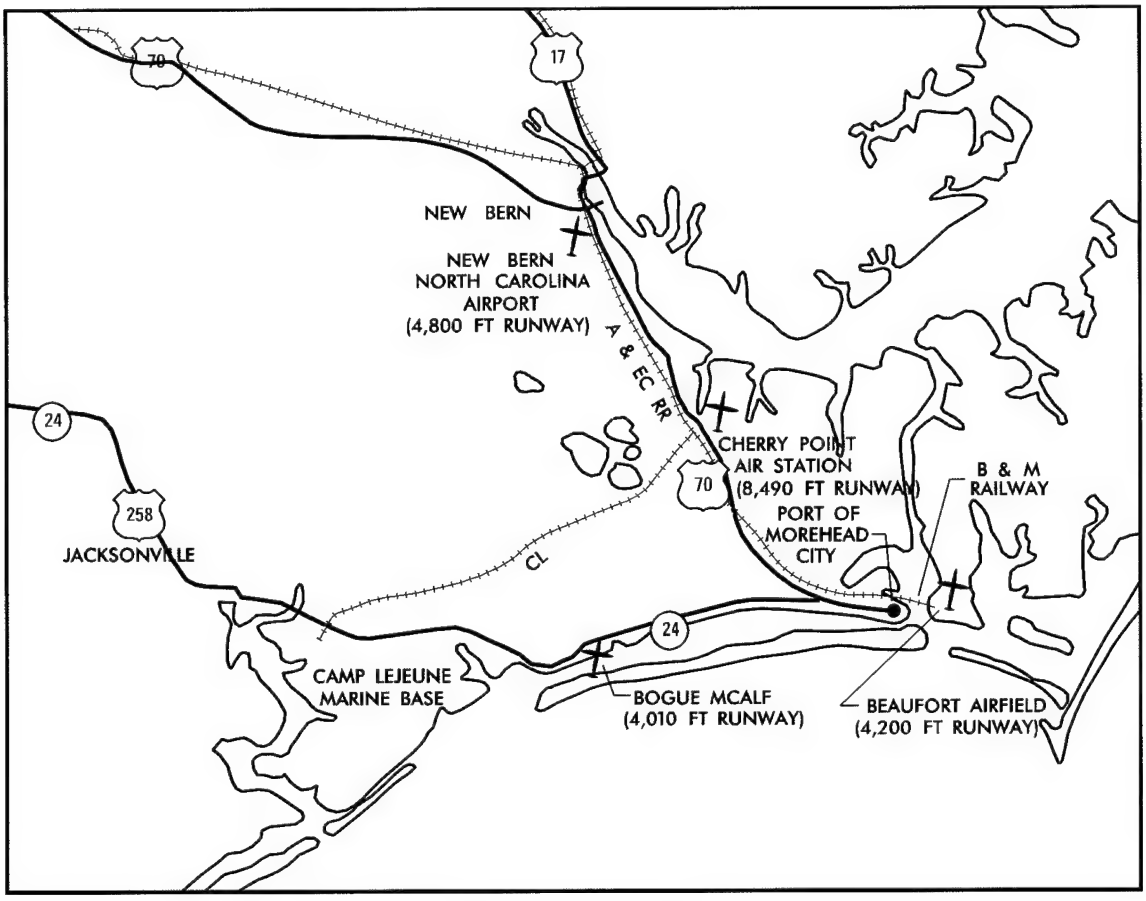
North Carolina Route 24 links the port to the Marine Corps Base, Camp Lejeune, and US 70 leads to the Marine Corps Air Station, Cherry Point.



Highway Access

Rail

The Port of Morehead City is served by the Norfolk Southern Railway and is linked with the Beaufort Morehead City Railroad (B&M). The switching railroad is owned by the North Carolina Ports Railway Commission. The railyards within the port have the capability to store 200 railcars. Areas west of the port and the nearby Radio Island, can hold more than 125 cars.



Air and Rail Access

Airports

The nearest commercial airport is the New Bern North Carolina Airport. It is approximately 30 miles northwest of Morehead City and has a 4,800-foot runway. Beaufort Airfield, which is a private airport, has 4,220 feet of runway. The nearest military airfields are Cherry Point Air Station, 20 miles from the port, and Bogue Marine Corps Air Landing Facility (MCALF).

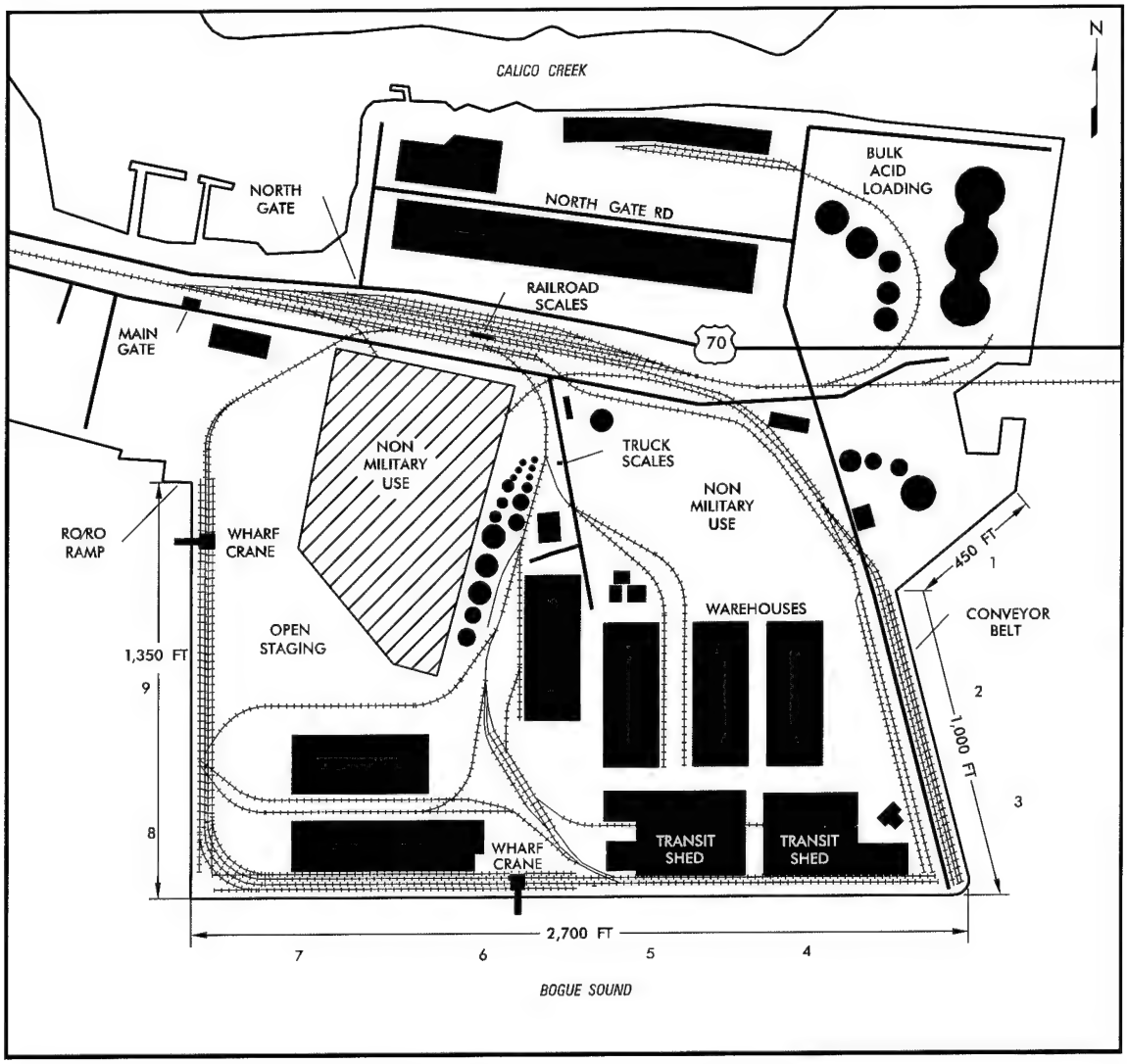
PORT FACILITIES

Berthing

The Port of Morehead City has one main terminal. Berths 2 and 3 have a conveyor for loading bulk cargo. Berth 4-7 has transit sheds to support conventional breakbulk cargo. Berth 8-9 is mainly used for RORO operations.

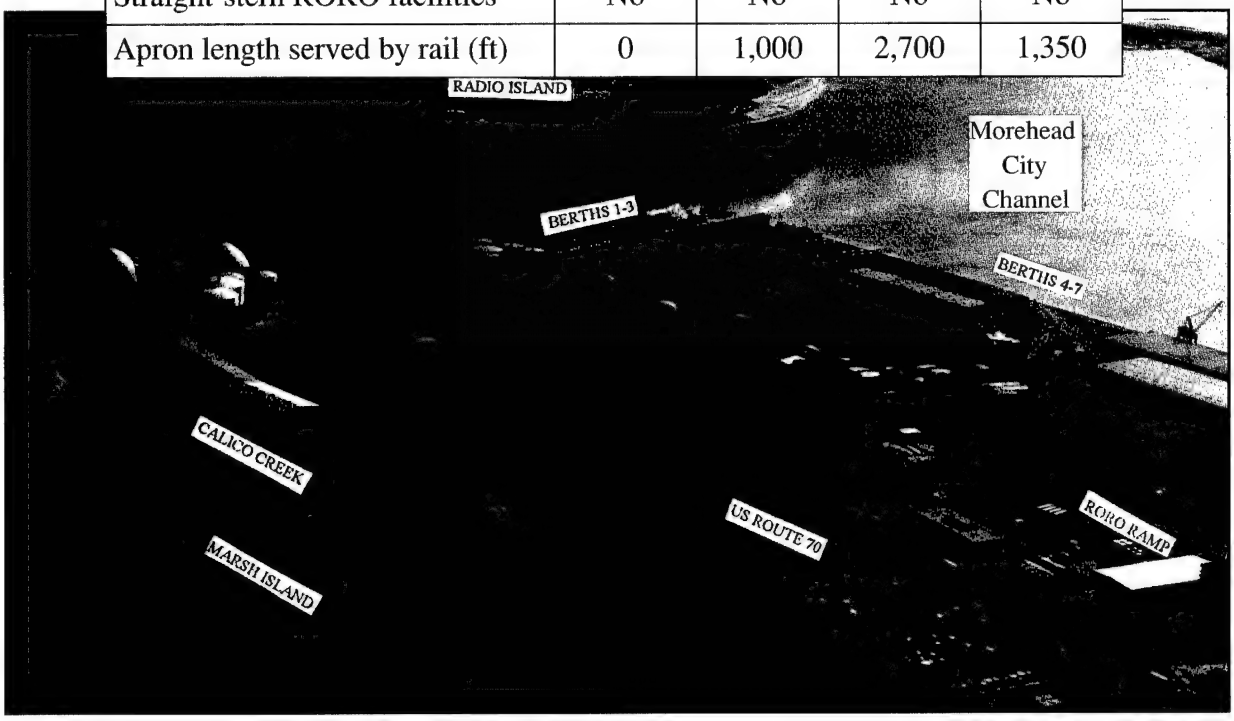
The deck strength varies throughout the port. Rubber fenders are on the bulkheads. The apron height averages 10 feet above MLW. Lighting is sufficient throughout the port to support night operations.

Below are land-use maps, aerial views of the port, and tables identifying the berth characteristics.



Port of Morehead City

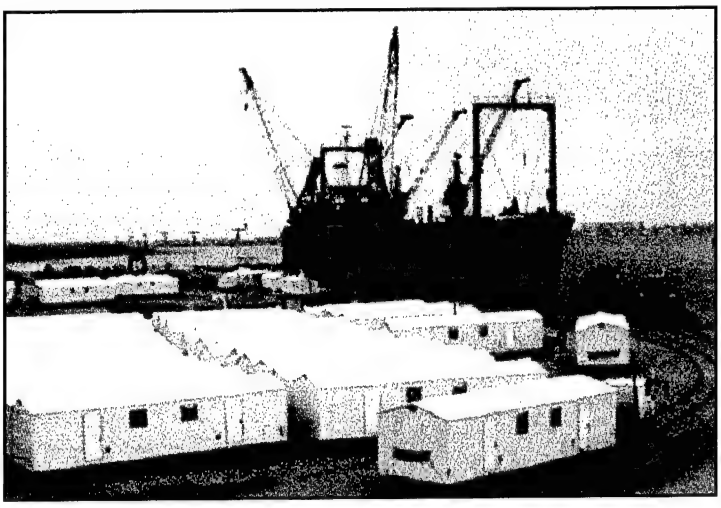
BERTHING CHARACTERISTICS				
Characteristics	**Berths**			
	1	**2-3**	**4-7**	**8-9**
Length (ft)	500	1,000	2,700	1,350
Depth alongside at MLW (ft)	45	45	35	35
Deck strength (psf)	1,000	1,000	1,000	1,000
Apron width (ft)	Open	50	45	Open
Apron height above MLW (ft)	10	10	10	10
Number of container cranes	0	0	0	0
Number of wharf cranes	0	0	1	1
Apron lighting	Yes	Yes	Yes	Yes
Straight-stern RORO facilities	No	No	No	No
Apron length served by rail (ft)	0	1,000	2,700	1,350



Port of Morehead City
(Southeastward View)

Staging

Open Staging. The Port of Morehead City has 14 acres of paved open staging. An additional 10 acres of open staging areas are on the nearby Radio Island, although most of it is undeveloped.

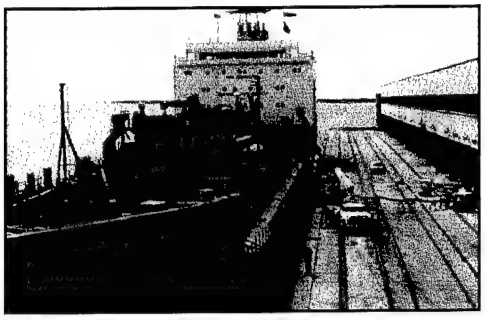


Open Storage adjacent to Berth 8-9 (Southward view)

Covered Staging. The port has three transit sheds along berth 4-7 that have more than 353,000 square feet of covered staging area. There are also five warehouses and two phosphate storage areas that have 457,000 and 223,000 square feet of storage, respectively.

Rail

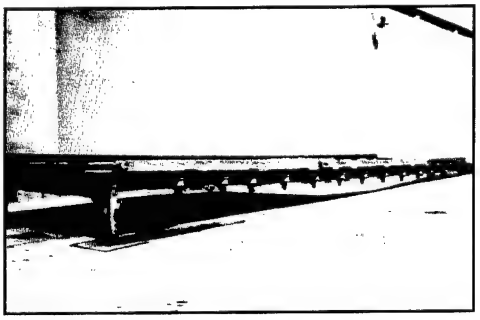
Rail trackage links the railyards to the port's apron tracks, transit sheds, and storage tracks. The port has a rail scale in the storage yard. The berths are served by two surface tracks, two platform level tracks, and two depressed tracks at the rear of the sheds.



Apron Tracks at Berths 6 and 7

Unloading/loading Positions

Ramps. The port has one fixed rail end ramp west of warehouse 6 and one portable steel end ramp. It also has a portable steel truck ramp for vans and flatbeds.



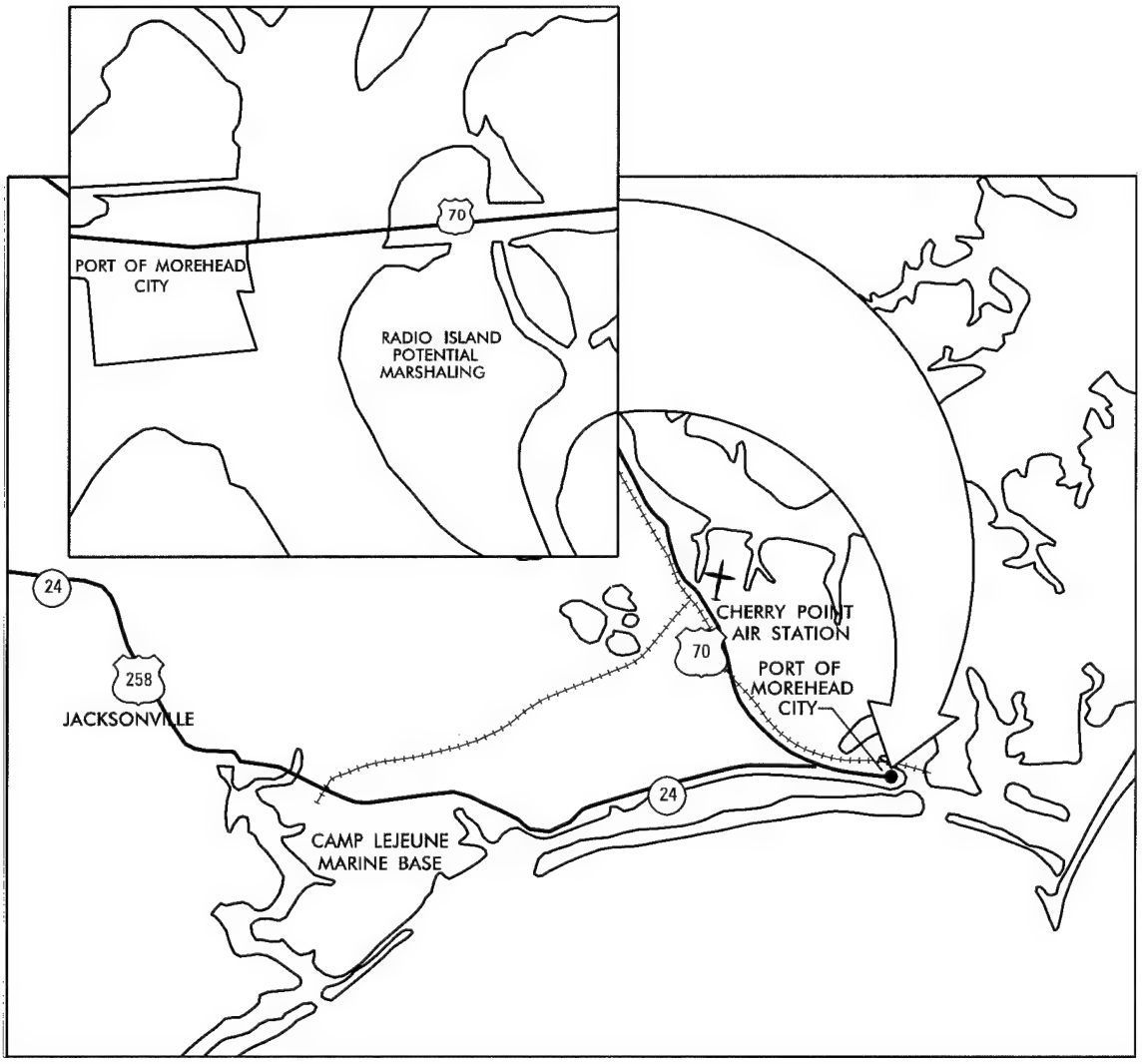
Portable End Ramp

Docks. Transit sheds 1 through 3 each have a truck dock at one end. Altogether, the terminals have 89 truck and 52 boxcar handling positions.

Marshaling Areas

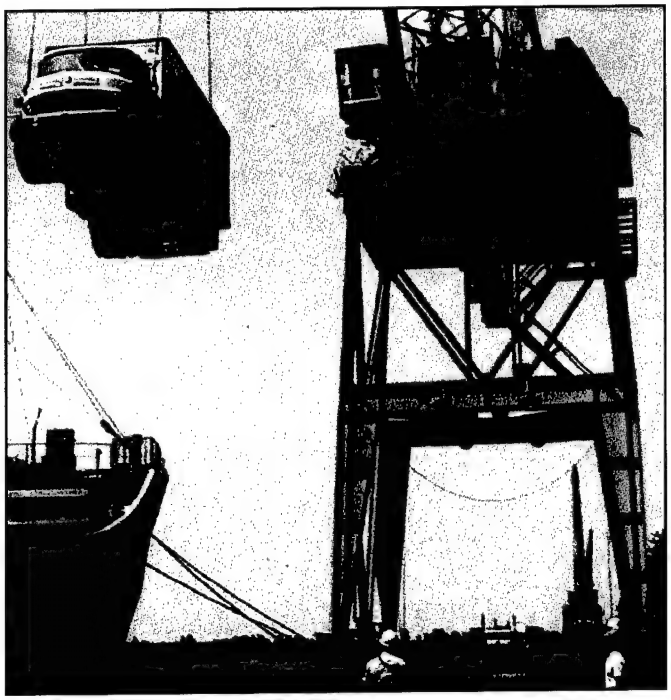
Within Port. A possible marshaling area is at the north end of the port, near Calico Creek.

Outside of Port. The nearby Radio Island has unused and undeveloped land that could be a possible marshaling area. There is also the possibility of using Camp Lejeune and Cherry Point for additional marshaling areas. Each of these offsites could provide 5 to 10 acres.



Potential Marshaling Areas

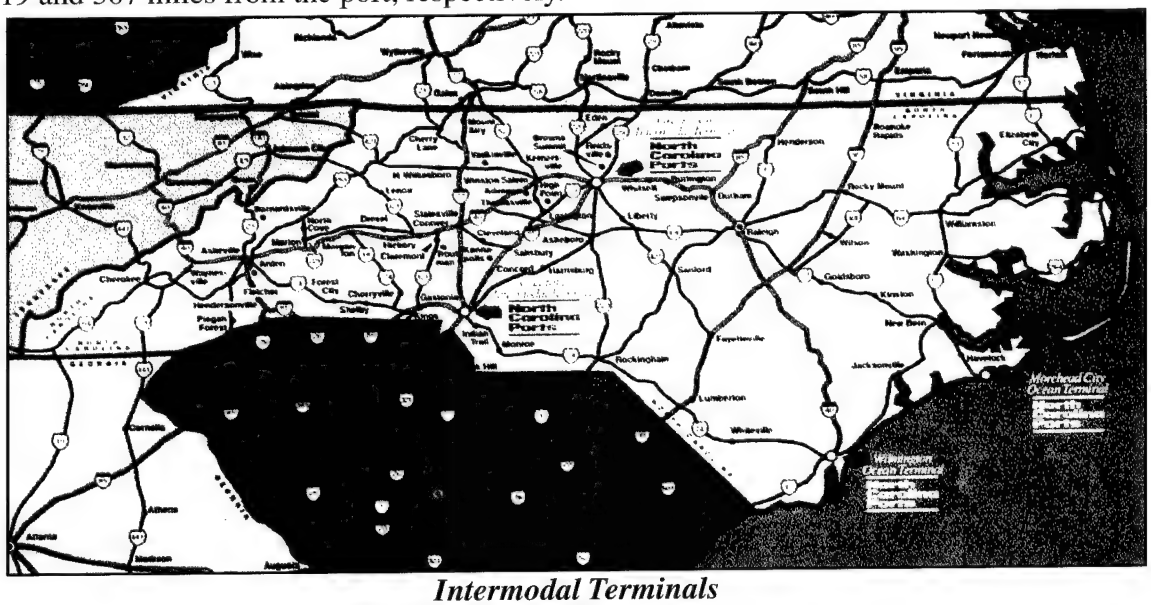
MATERIAL HANDLING EQUIPMENT (MHE)



The Port of Morehead City has two gantry cranes with a 115-ton capacity. Both cranes are at the southwest side of the port. One is used by berth 6-7 and the other is used by berth 8-9. Other MHE includes 36 lift trucks with capacities ranging from 4,000 to 15,000 pounds, forklifts, yard tractors, road tractors, road trailers, a pair of front end loaders, flat trailers, and portable conveyors.

INTERMODAL FACILITIES

Two facilities in the North Carolina area are the Greensboro and Charlotte Terminals, located 219 and 307 miles from the port, respectively.



Intermodal Terminals

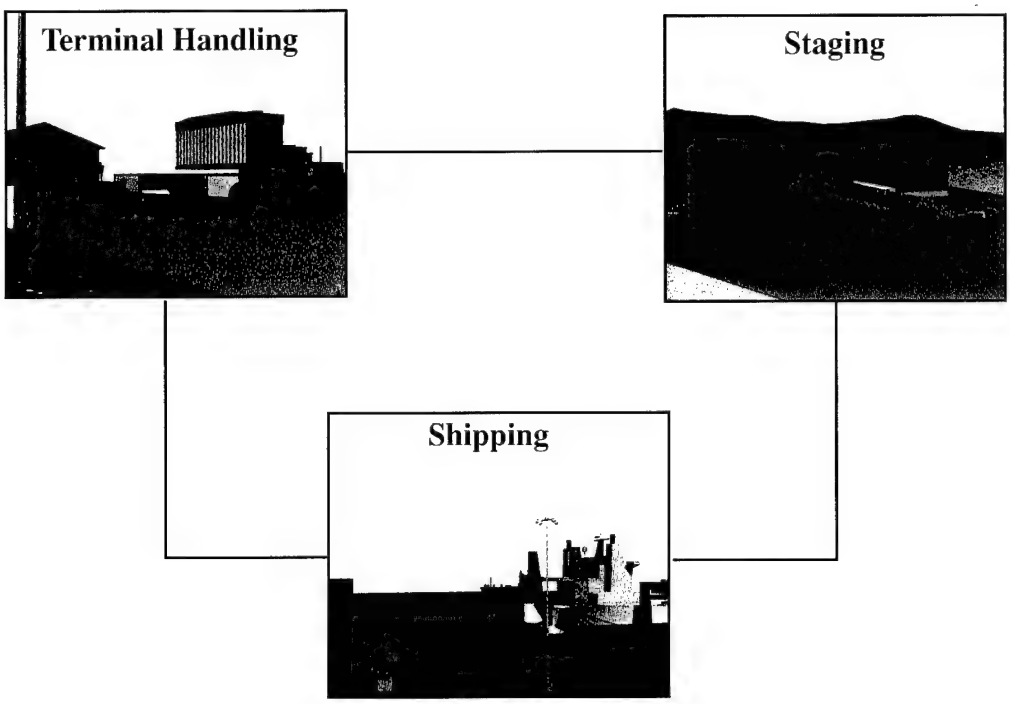
FUTURE DEVELOPMENT

Presently, no plans are being developed for future growth. However, some undeveloped acreage surrounds the port. There is more land available for development on Marsh Island to the north and Radio Island to the east.

II. THROUGHPUT ANALYSIS

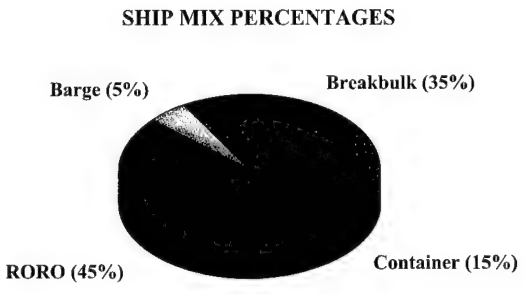
GENERAL

This section evaluates the throughput capability of the Port of Morehead City using the port operational performance simulator (POPS) computer model. The model is based on a weak-link analysis in which each subsystem is analyzed separately and then compared to find the least capable subsystem. The weakest subsystem defines the maximum throughput capability of the terminal. The model yields throughput capability values for three subsystems - shipping, staging, and terminal processing/handling - in terms of measurement tons (MTON) per day.



Terminal Throughput Subsystems

The analysis assumes a maximum of 80 percent of the port facilities can be made available at any one time. For this reason, we ran all port analyses using an 80 percent facility use factor. Also, the ship mix is based on Desert Shield and Desert Storm statistics. We weighted the percentages to adjust for differences in cargo deadweights and expectations for future deployments.



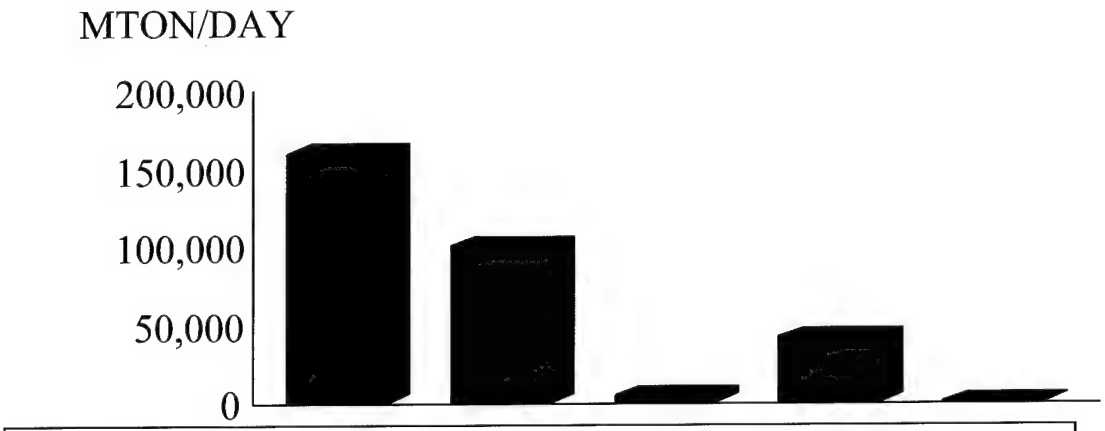
TERMINAL RECEPTION/HANDLING

Highway. US Route 70 and North Carolina Route 24 provide access to the port. The terminal has a designated entrance for trucks. The road network in and out of the terminal, including the gate processing of vehicles, could handle about 100,000 MTON of equipment and supplies per day.

Roadable vehicles in convoys will process directly to the staging areas. Vehicles on commercial or military flatbed trailers without integral ramps will offload using the portable truck ramp. There are no permanent truck end ramps at the port.

Supplies in van semitrailers will proceed to the van-handling positions. These docks can offload more than 42,000 MTON of van semitrailer-shipped materials per day.

HIGHWAY RECEPTION/HANDLING CAPABILITY



SUBSYSTEMS	HIGHWAY	GATES	END-RAMPS*	DOCKS	CONTAINERS
MOREHEAD CITY ■	160,000	100,000	4,800	42,000	1,100

*1 portable or temporary ramp is assumed available.

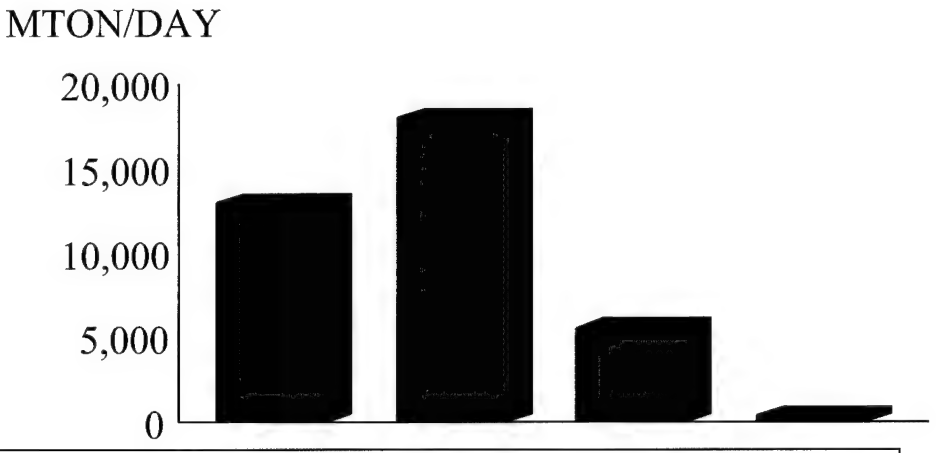
Rail

Rail reception at the port is fairly good with two railroad companies accessing the area. The berths have two surface tracks, two platform level tracks, and two depressed tracks at the rear of the transit sheds.

This analysis assumes the port's portable rail end ramp is available. This would be in addition to the ramp regularly used. We assume the portable ramp would be used near covered storage or at the rail storage location, with 650 feet of tangential track.

Boxcars could offload at the transit sheds where about 52 boxcar handling positions are available.

RAIL RECEPTION/HANDLING CAPABILITY



SUBSYSTEMS	TRACKAGE	END-RAMPS*	DOCKS	COFC
MOREHEAD CITY ■	13,000	18,000	5,600	370

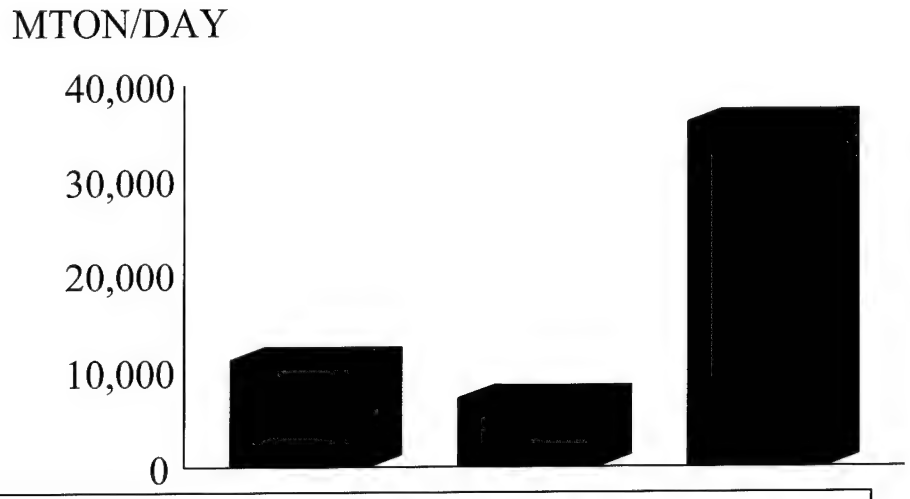
*1 fixed ramp and 1 portable ramp are assumed available.

STAGING

The port has a total of about 14 acres of open paved staging. There is also about one-half million square feet of covered sprinklered storage.

The terminal can perform operations on RORO, container, or breakbulk ships. The cargo mix depends on the anticipated vessel type. For example, cargo will be containerized if a containership is planned. The chart below provides the staging capability for each of these vessel types. If a combination ship is expected, then a portion of each involved capability should be assumed.

OPEN STAGING CAPABILITY

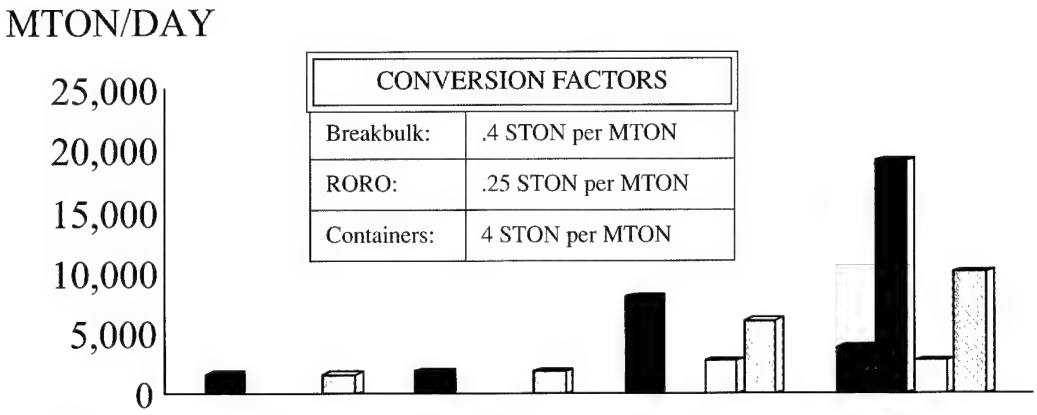


VESSEL TYPE	RORO	CONTAINERS	BREAKBULK
MOREHEAD CITY ■	11,000	7,000	36,000

SHIPPING

Throughputs for each berth are shown below. They are based on various factors including MHE used, loading, operational, and berth usage rates as well as berth/ship compatibility. We indicate these factors in Appendix A.

BERTH THROUGHPUT CAPABILITY



BERTH	B-1	B2-3	B4-7	B8-9
BREAKBULK	1,600	1,900	8,000	3,800
RORO	0	0	0	19,000
CONTAINER	0	0	2,700	2,700
MIXED	1,600	1,900	6,000	10,000

The type of ship preferred at each berth is based on the methodology described in appendix B. The evaluation is based on a snapshot view of the current physical characteristics of the berths and the MHE available. The evaluation to the right gives no considerations for enhancements, such as equipment. The lower the number for a berth, the better the berth is suitable for the loading operation.

PREFERENCE BERTH SELECTION

BERTH	BB	RORO	CNTNR
1	4	-	-
2-3	3	-	3
4-7	1	-	2
8-9	2	1	1

Berth 8-9 can support FSS and LMSR operations. Although water depth is greater at the other berths, the aprons are obstructed by buildings and/or conveyor systems, which makes them unsuitable for FSS and LMSR operations.

SUMMARY OF BERTHING CAPABILITIES

Vessel	Berths			
	1	2-3	4-7	8-9
Breakbulk				
C3-S-33a	1	1	5	2
C3-S-37c	1	1	5	2
C3-S-37d	1	1	5	2
C3-S-38a	1	1	5	2
C4-S-1a	c	1	4	2
C4-S-1qb and 1u	c	1	4	2
C4-s-58a	c	1	4	2
C4-S-65a	c	1	4	1
C4-S-66a	c	1	4	2
C4-S-69b	c	1	4	2
Seatrain				
GA and PR-class	c	1	4	2
Barge				
LASH C8-S-8lb	c	1	3	1
LASH C9-S-81d	c	1	a	a
LASH lighter	3	7	19	9
SEABEE C8-S-82a	c,g	g	a,g	a,g
SEABEE barge	2	5	13	6
RORO				
Comet	d,i,j	d,o	d,o	i,j
C7-S-95a/Maine-class	c	b	b	1
Ponce-class	c,h	b,h	b,h	h
Great Land-class	c,h	b,h	b,h	h
Cygnus/Pilot-class	c	b	b	2
Meteor	c,d	d,o	d,o	i,j
AmEagle/Condor	c	b	b	i,j
MV Ambassador	c,d	d	d	2,m
FSS-class	c	b	b	1
Cape D-class	c	b	b	i,j
Cape-H class	c	b	a,b	a
LMSR	c	b	1	1
Container				
C6-S-1w	c,e	1,e	3,e	1,e
C7-S-68e	c,e	1,e	3,e	1,e
C8-S-85c	c,e	1,e	3,e	1,e
Combination				
C5-S-78a	c,e	1,e	4,e	2,e
C5-S-37c	c,e	1,e	4,e	2,e

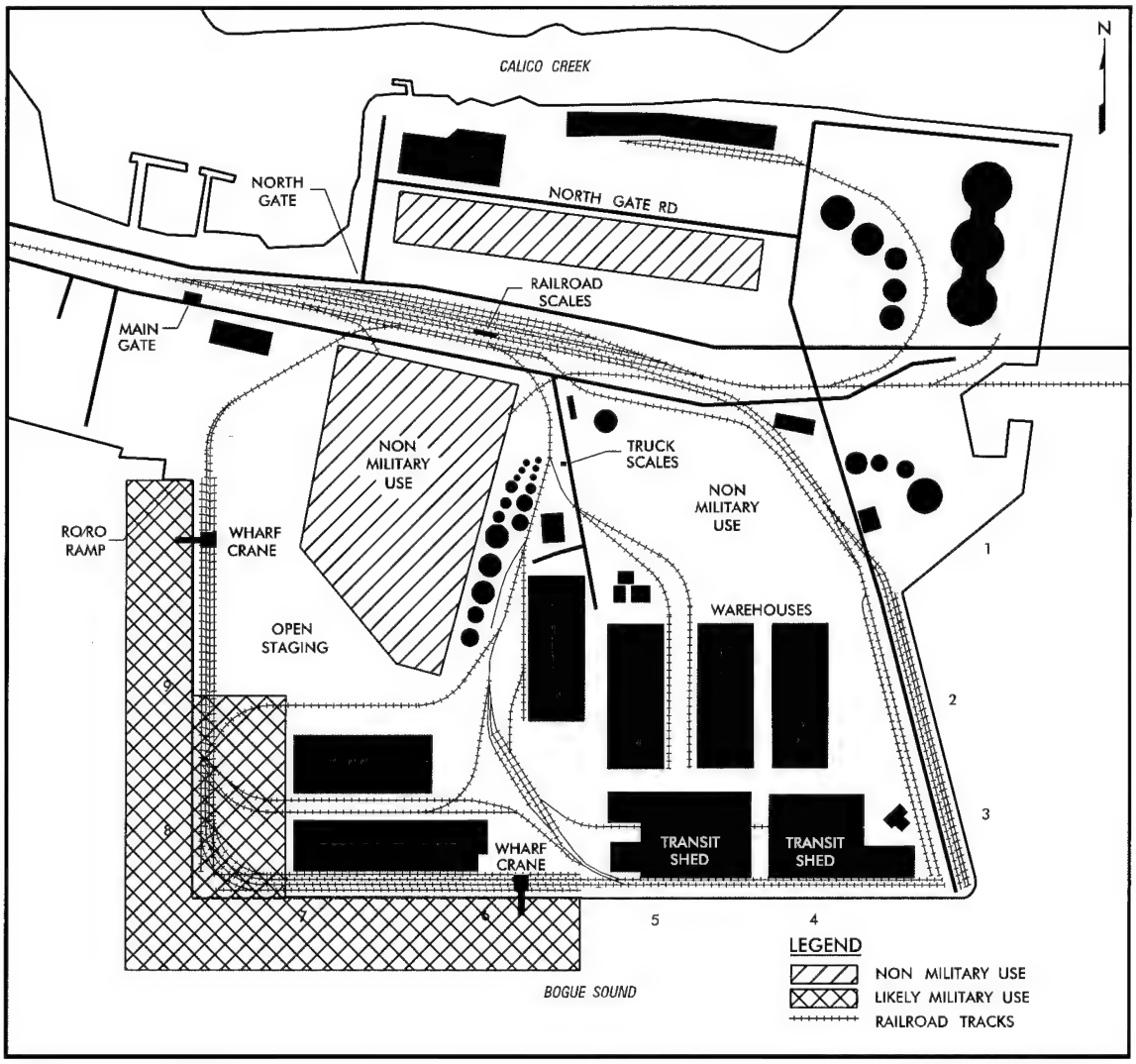
a=vessel draft limited to berth depth
b=inadequate apron width
c=inadequate berth length
d=no straight stern-ramp facilities
e=no container-handling equipment
f=shallow berth, adequate anchorage depth
g=inadequate channel depth
h=no shore-based ramps available
i=insufficient ramp clearance at low tide
j=insufficient ramp clearance at high tide
k=excessive ramp angle at low tide
m=excessive ramp angle at high tide
n=parallel ramp operation only
o=too narrow apron for side-ramp

Notes: Ramp clearance and ramp angle based on maximum vessel drafts.
( ) indicates vessels assigned by analyst

III. APPLICATION

GENERAL

This section will evaluate the port's throughput capability for deploying a notional mechanized infantry brigade using primarily FSS vessels. The August 1994 revision for the ***Planning Orders Digest***, issued by MARAD, provided an agreement for the military to use the Port of Morehead City. It called for use of berth 6-7, berth 8-9, and 7 acres of adjacent open storage. Although these agreements expired 1 July 1995, we expect they will be renewed without significant change, until 15 June 1997. New planning orders are being considered at the time of this publication.



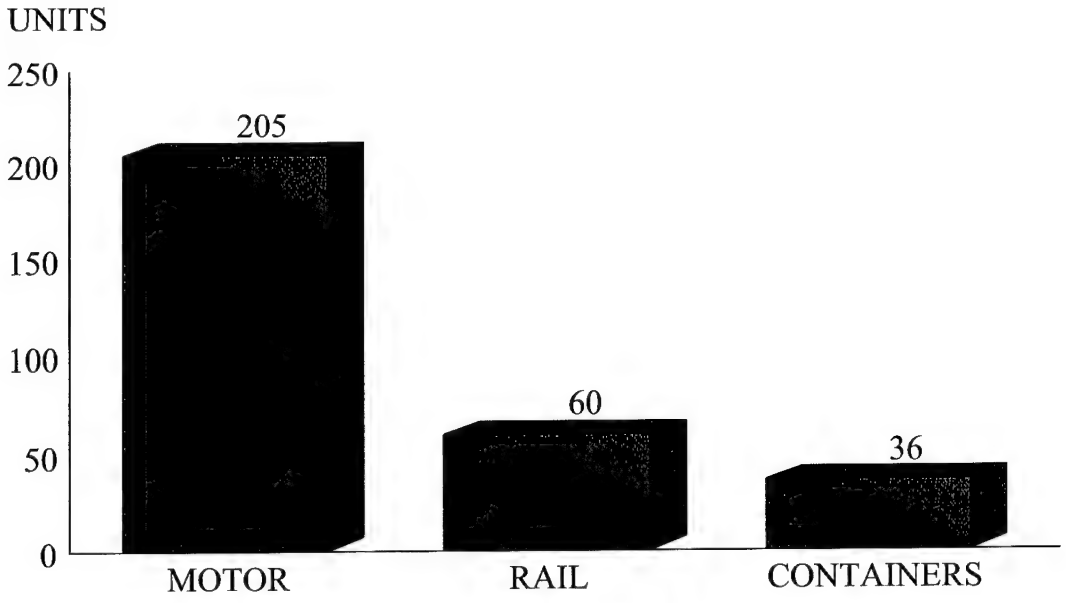
Facilities likely to be used for Military Operations

REQUIREMENTS

The likely requirement for the Port of Morehead City is to deploy a notional mechanized infantry brigade in 6 days. The brigade has to move about 2,600 vehicles and 220 containers. The movement to the port will require 360 railcars (60 per day) using the convoy/rail option. Under this option, about 1,200 (205 per day) roadable vehicles would be driven and about 775 (130 per day) would be towed.

MECHANIZED INFANTRY BRIGADE	
Total Equipment	
Volume	91,506 MTON
Weight	31,670 STON
Area	474,300 SQ FT
Vehicles	2,600
Containers	220

DAILY REQUIREMENTS

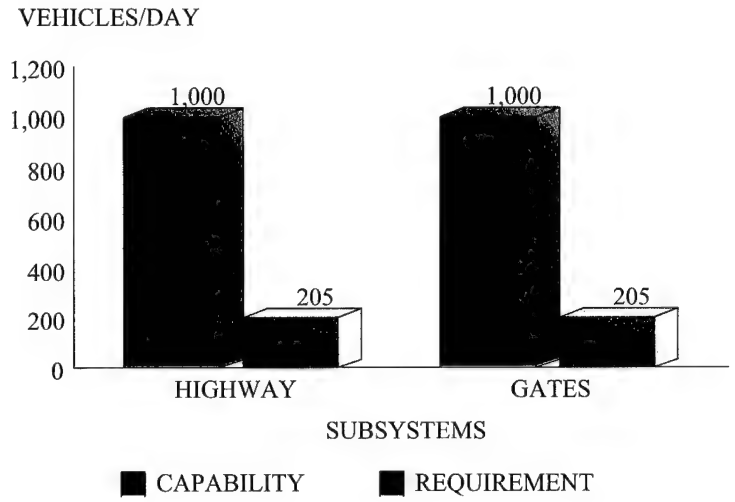


TERMINAL HANDLING

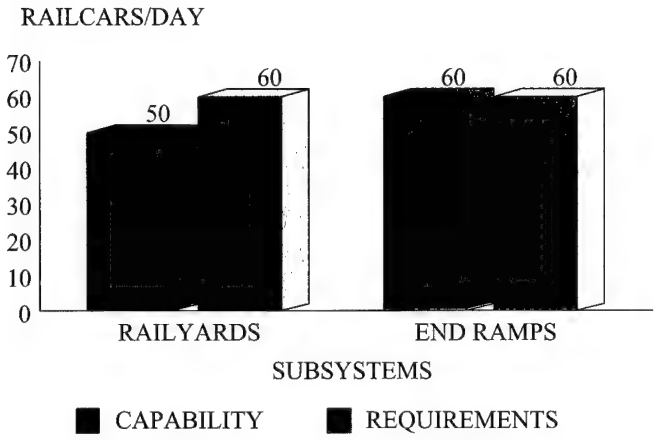
Highway

The major connector routes to the port are US Route 70 and North Carolina Route 24. Vehicles and containers on chassis would access the terminal through the main gate via Arendell Street. The access roads and gates can handle well over 1,000 vehicles per day.

HIGHWAY INPROCESSING CAPABILITY



RAIL INPROCESSING AND HANDLING CAPABILITY



Rail

The railyard within the port area can receive only about 50 railcars without disrupting the simultaneous commercial operations. This does not meet the requirement of the unit. There are other railcar storage locations on Radio Island and areas west of the port that could store in excess of 125 cars.

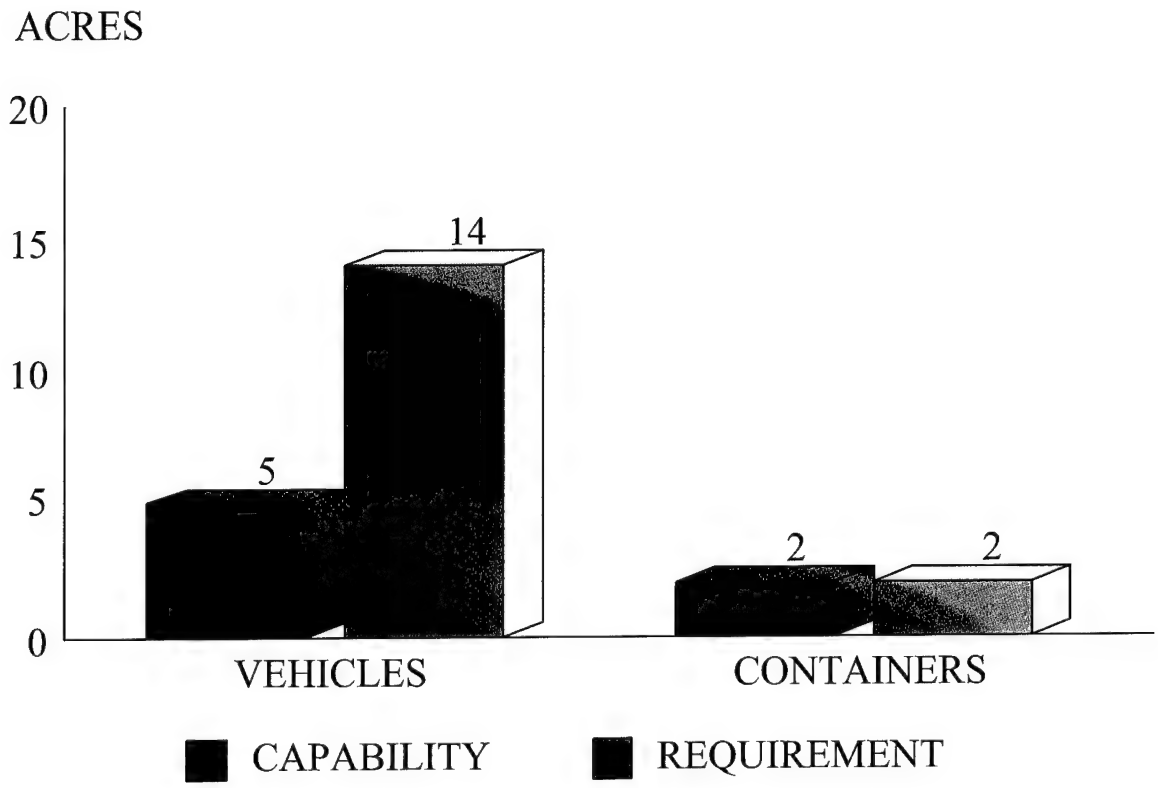
The fixed ramp west of warehouse 6 can support offloading eight railcars. The port's portable end ramp can easily support offloading seven additional railcars at any of several locations. We recommend using the adjacent track (also west of warehouse 6) if available. Offloading these 15 railcars every 5 hours will meet the 60 railcar per day requirement.

STAGING

This analysis assumes that current downsizing continues, and that three FSS-sized ships will deploy an entire notional mechanized infantry brigade. One ship will depart every two days.

Although an FSS load of cargo can be staged and loaded on 10 acres, 16 acres are required for sustained loading operations. Of these 16 acres, about 2 acres are required for staging containers. In addition to the acreage in the August 1994 Planning Orders, nine more acres are required. If the acreage on the port is not available, the adjacent Radio Island could provide offsite staging to meet the 16 acre requirement.

OPEN STAGING CAPABILITY



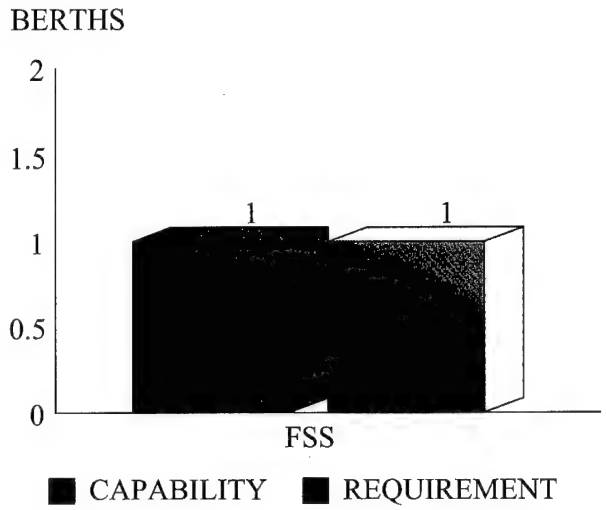
SHIPPING

Although this analysis assumes that three FSS-sized ships can deploy the notional mechanized infantry brigade, the table below provides ship quantities for the current brigade size. The number of ships required depends on the shipping mix selected. Berth 8-9 can support FSS and LMSR operation. This berth alone meets the requirement.

The apron of berth 6-7 is too narrow for FSS side ramp operations, but LMSR vessels can load by placing the stern ramp between the transit sheds.

This berthing capability meets the one-FSS berthing requirement. If LMSR vessels are used, the berthing capability exceeds the requirement.

FSS SHIPPING CAPABILITY



UNIT MOVEMENT REQUIREMENTS
MECHANIZED BRIGADE

Loading Condition/ Sample Ship Mix	Vessel Types			
	FSS (RORO/Comb)	Cape H (RORO/Comb)	C3/C4 (Breakbulk)	C6/C7/C8 (Container)
Minimum Containerization:				
All FSS	3.33			
FSS and Cape H	2.22	1.00		
All Breakbulk			12.57	
Maximum Containerization:				
FSS, and Container	2.64			0.67
FSS, Cape H, and Container	1.54	1.00		0.67
Breakbulk and Container			9.86	0.67

Legend:
RORO - roll on/roll off
FSS - fast sealift ship
Source: MTMCTEA Report OA 90-4f-22, Deployment Planning Guide. Aug 91.

SUMMARY

The Port of Morehead City has adequate characteristics to support the deployment of a brigade as long as 9 acres are added to the 7 acres provided by the Planning Orders. Berth 8-9 is best suited for all-around operations due to crane access, adjacent open storage, and available RORO ramp.

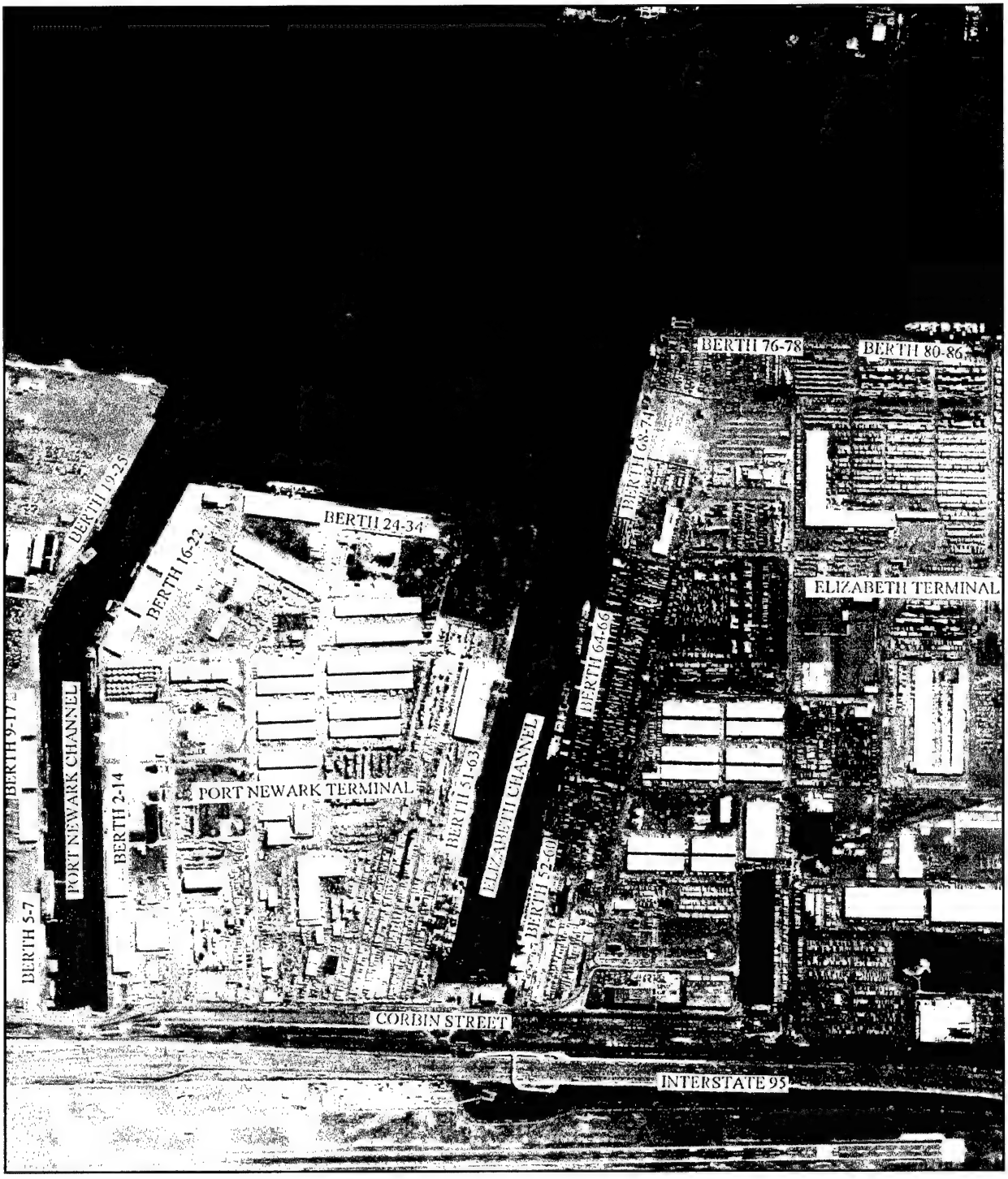
The port harbor east turning basin, which has a diameter of 1,420 feet, is large enough for FSS, LSMR, and Cape H vessels to turn

RECOMMENDATION

We recommend use of the Port of Morehead City for deploying a mechanized infantry brigade as long as the following conditions are met:

- Nine staging acres are added to those called for by the now expired Planning Orders.
- Ten railcar per day offsite reception is available to supplement the capability of the port's railyard.
- The port's portable rail ramp is available to supplement the fixed rail end ramp of the port.

PORT OF NEW YORK/NEW JERSEY



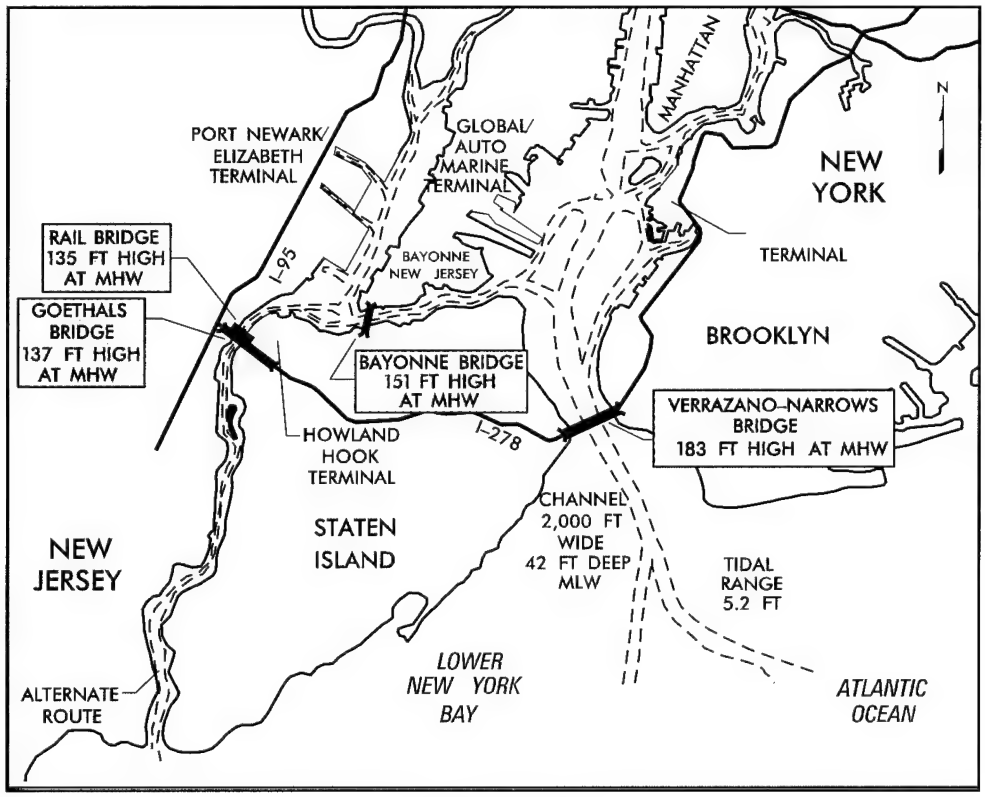
I. GENERAL DATA

TRANSPORTATION ACCESS

Water

The Port of New York and New Jersey is the largest port on the east coast and consists of several terminals. The port consists of more than 2,100 acres, 8 miles of berthing, and 76 miles of railroad tracks. The channel that provides access to the Port of New York and New Jersey has a water depth ranging from 35 feet in the smaller waterways to 40+ feet throughout the rest of the Upper and Lower New York Bay at mean low water (MLW). The port is only 9 miles from the Atlantic Ocean. The mean tidal range throughout the port is 5.2 feet. This report will only consider the Port Newark/Elizabeth, Global Marine, Auto Marine, Red Hook, and Howland Hook Terminals.

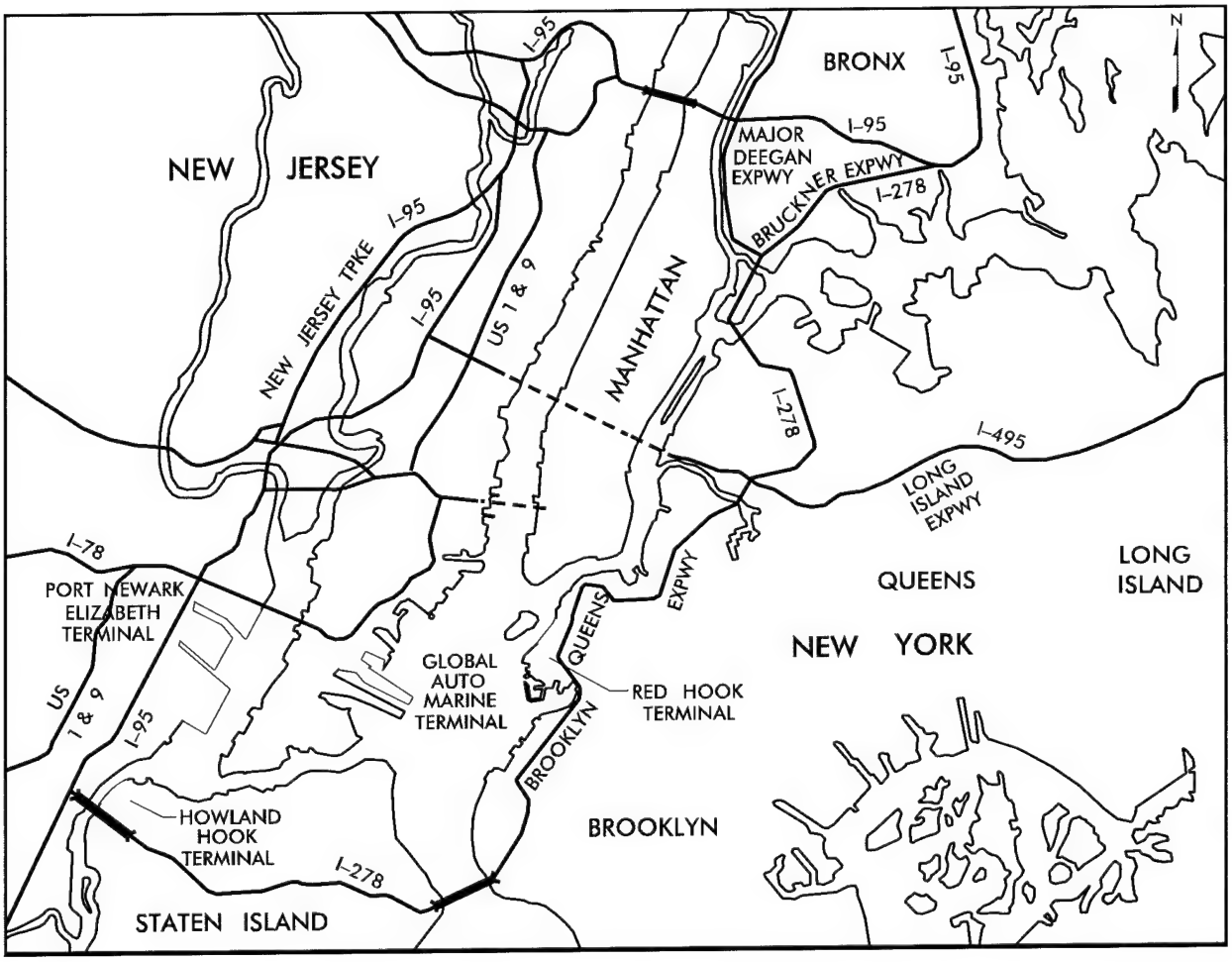
The only overhead obstruction for the terminals of this report is the Verrazano-Narrows Bridge with a vertical clearance of 183 feet at mean high water (MHW). The channel leading to the Port Newark/Elizabeth and Howland Hook Terminals is crossed by the Bayonne Bridge, with a clearance of 151 feet MHW. Neither of these bridges restrict ships.



Water Access

Highway

The Port of New York and New Jersey is in a heavily populated region. Anticipate heavy but moving traffic when using any route named in this report. Highways accessing the port area are Interstate Routes 95 (New Jersey Turnpike), 495, and 278; US Routes 1 and 9; and. The numerous toll plazas make highway travel throughout the region even more difficult. I-78 leads directly into the Port Newark Terminal.



Highway Access

Rail

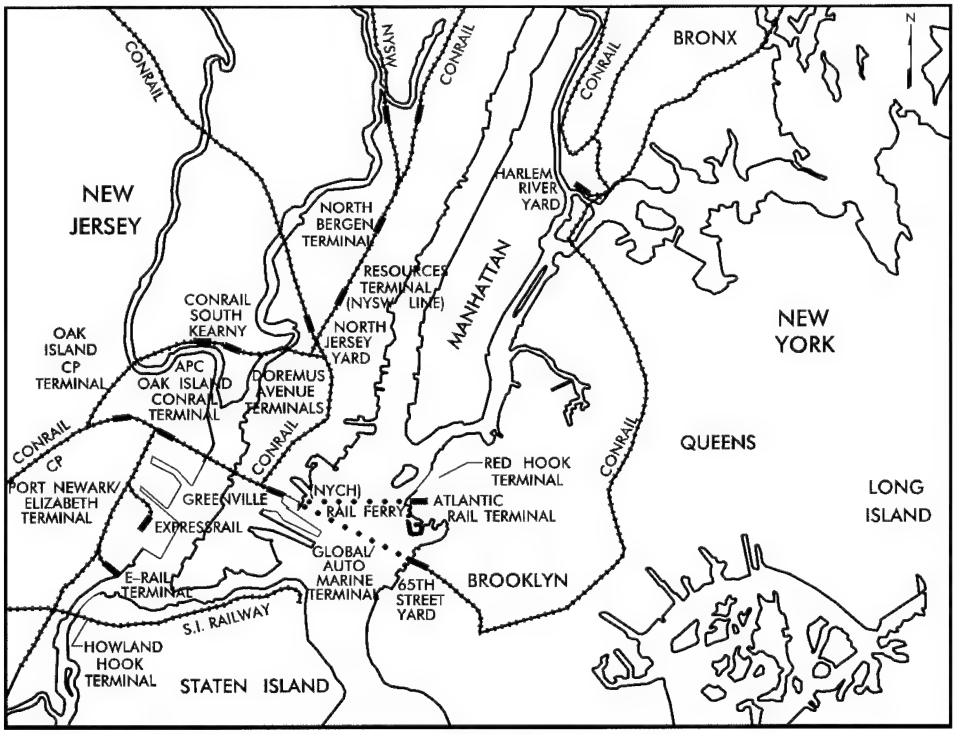
The main rail carrier for the Port of New York and New Jersey is Conrail. Both Conrail and the New York, Susquehanna and Western Railway have double-stack capability. The port is served by more double-stack rail service than all others on the east coast. Maher Terminal at Port Elizabeth operates Express-Rail, which links on-dock rail service to many major midwestern and Canadian cities on a daily basis. This double stack intermodal terminal gives quick and efficient rail access and can connect to any point in the United States.

Rail Service

Terminal	Rail Reception	
	Trains per Day	Railcars per Train
Port Newark	2	60
Port Elizabeth	2	60
Global Marine	1	60
Red Hook	1 (indirect)	60
Howland Hook	2 (expected)	60

Rail service varies from day to day. The values in the table at right are conservative for the full capability of each terminal. These values were used for this analysis.

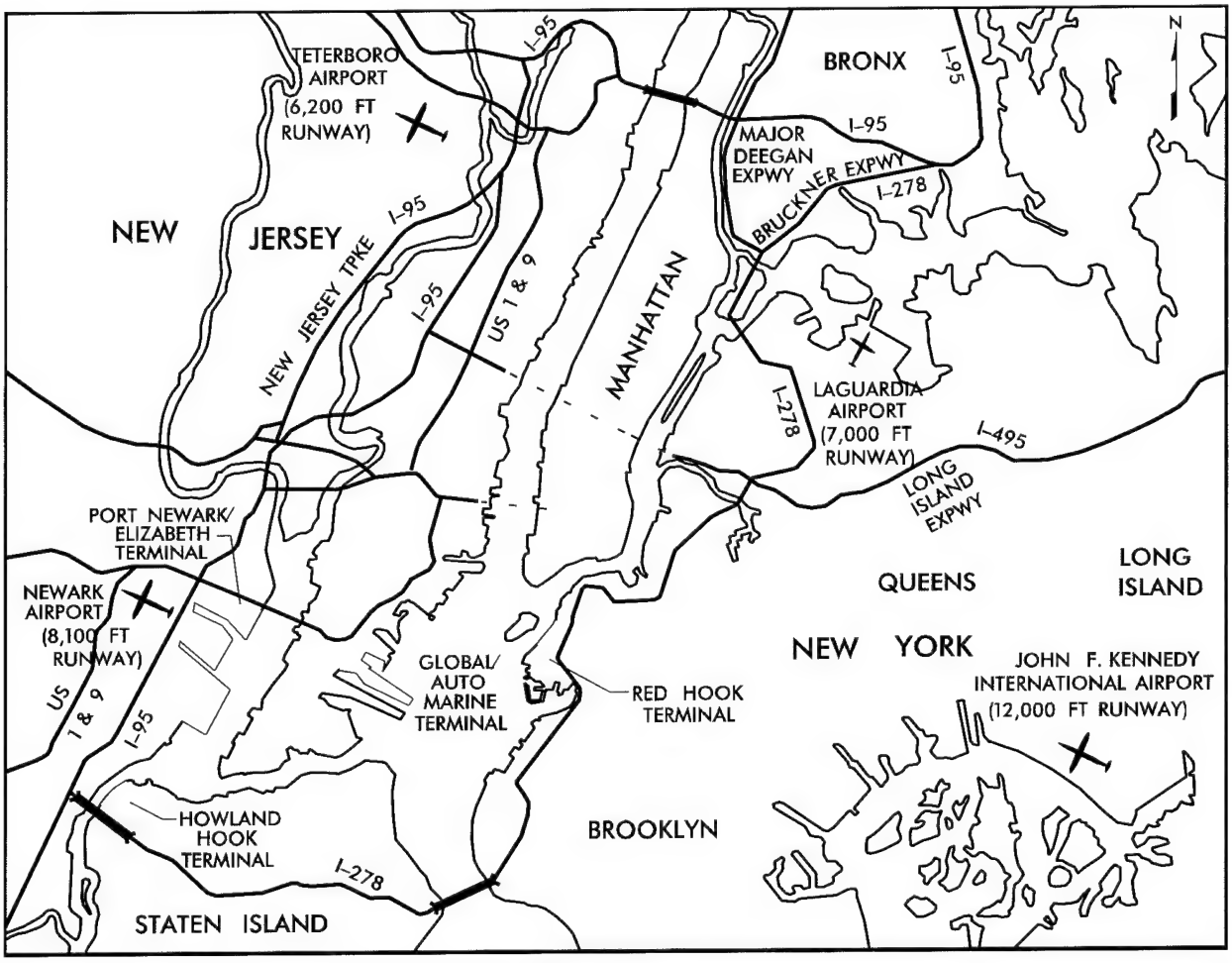
The Howland Hook Terminal rail access is out of service at time of publication. The Port Authority expects the service to be restored in late 1996 or 1997. We expect the line will support full DoD clearance and weight requirements, but we cannot be certain until the restoration is complete. Of the remaining terminals, only the Red Hook and Auto Marine Terminals do not have direct rail access. Rail-transported cargo is drayed less than a mile to the Red Hook Terminal, and from the adjacent Global Terminal to access the Auto Marine Terminal.



Rail Access

There are several railyards throughout the port to accommodate over 1,000 railcars.

Three major airports are in the port area. The two largest are Newark International, which is separated from the Port Newark/Elizabeth Terminal by I-95 less than a mile away; and John F. Kennedy International, located in Queens. The other, LaGuardia Airport, is northeast of the port. The smaller commuter Teterboro Airport is north of the port.

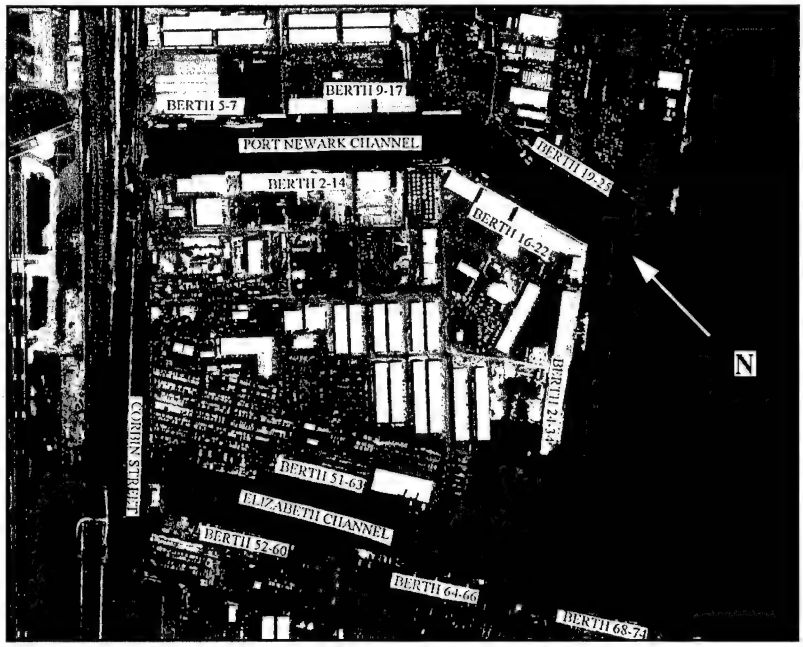


Air Access

PORT FACILITIES

Berthing

This report covers five areas of the port. Each area is considered a terminal, although each may involve several shipping lines. For this report, we will consider the Port Newark/Elizabeth, Global Marine, Auto Marine, Red Hook, and Howland Hook Terminals.



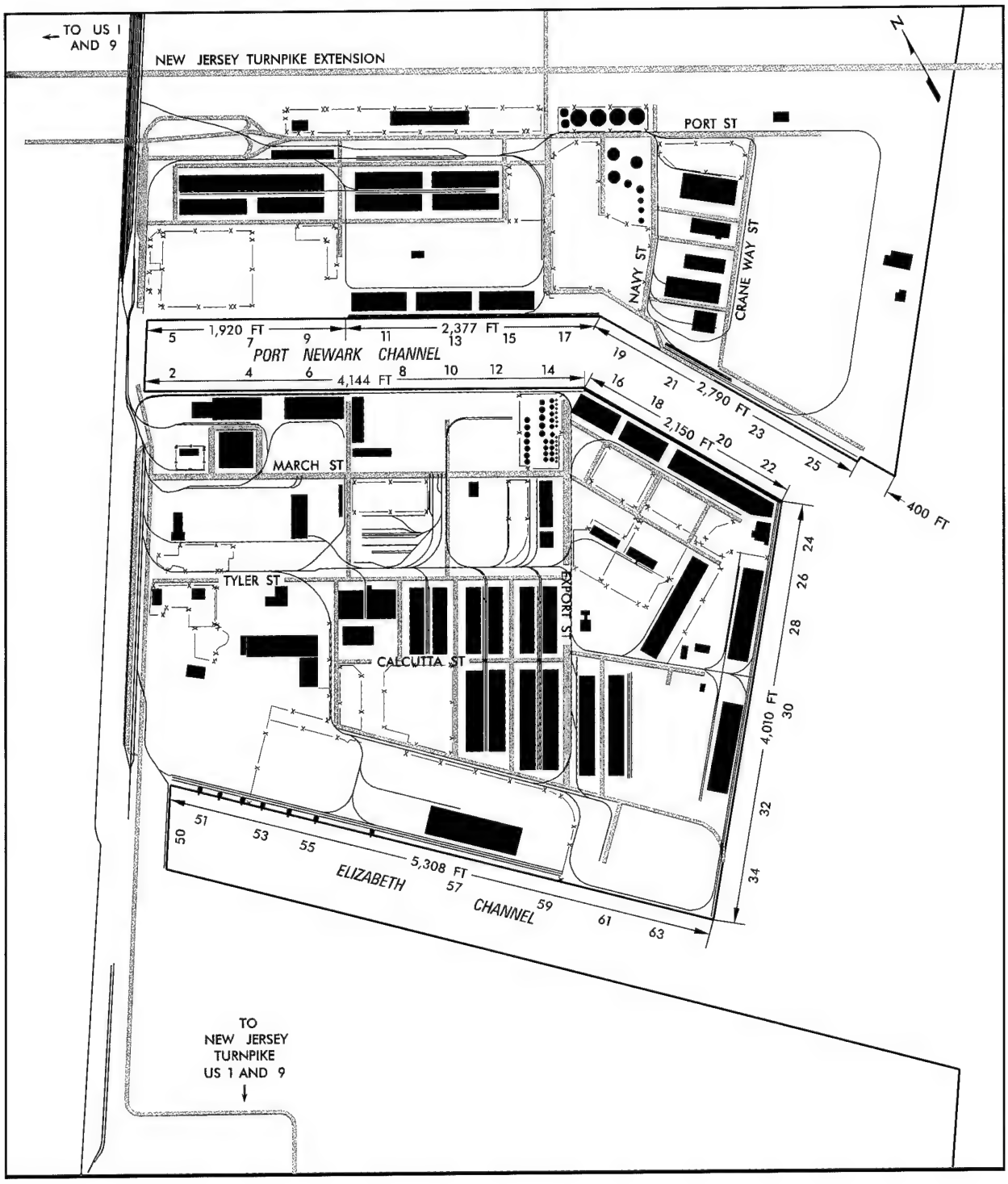
These terminals are primarily container facilities. Some facilities have transit sheds to support conventional breakbulk cargo. The Auto Marine Terminal is used mainly for RORO operations of small vehicles.

Pier construction is generally concrete retaining walls with asphalt-surfaced solid fill over concrete relieving platforms. These relieving platforms are supported by steel, concrete, or timber piles. Fenders are generally timber. All container terminals have lighting for night operations. Portable lighting is available from local stevedore companies.

BERTHING CHARACTERISTICS OF PORT NEWARK TERMINAL

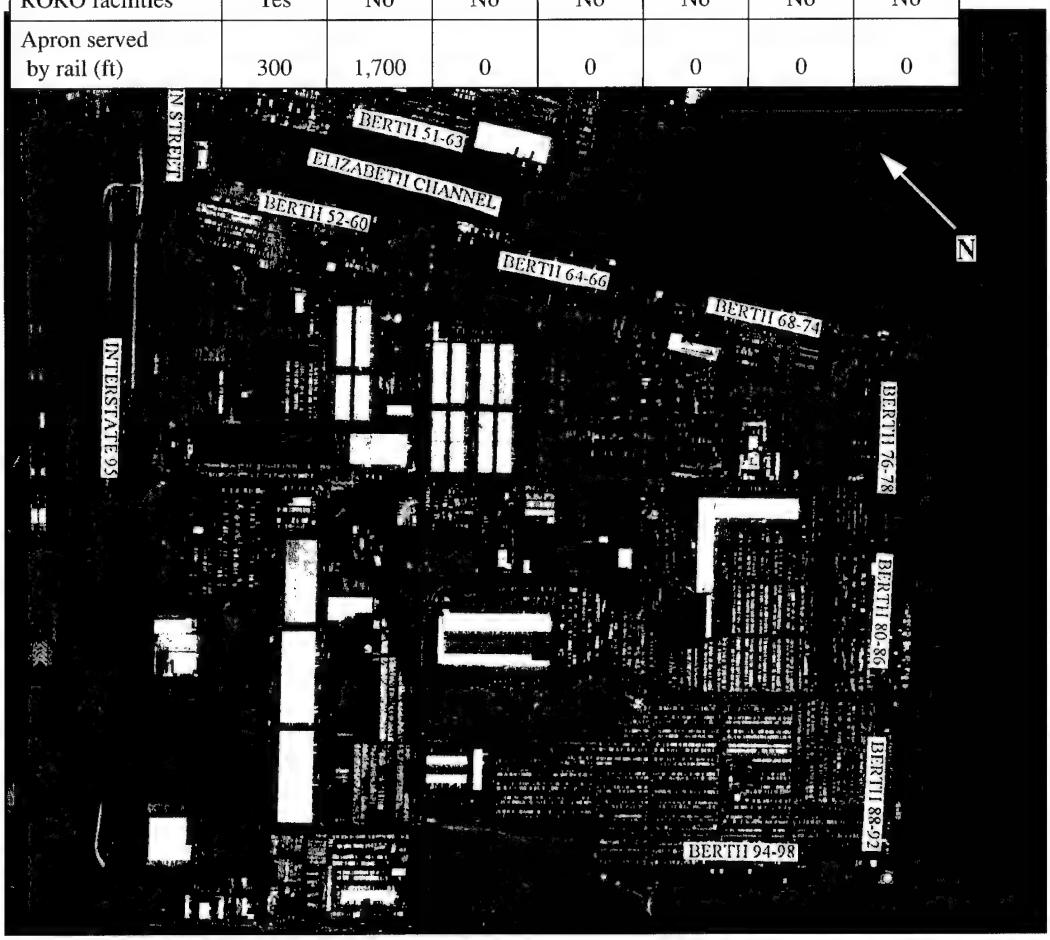
Characteristics	Berths						
	5-7	9-17	19-25	2-14	16-22	24-35	51-63
Length (ft)	1,374	2,923	2,790	4,144	2,150	4,010	5,308
Depth alongside at MLW (ft)	35	35	35	35	35	35	37
Deck strength (psf)	500	500	500	1,000	500	500	500
Apron width (ft)	Open	56	Open	Open	50	50	Open
Apron height above MLW (ft)	11	11	11	11	11	11	11
Number of container cranes	0	0	0	0	0	0	10
Number of wharf cranes	0	0	0	0	0	0	0
Apron lighting	No	Yes	No	No	No	No	No
Straight-stern RORO facilities	No	No	No	No	No	No	No
Apron served by rail (ft)	0	2,923	2,150	2,500	0	2,000	3,822

Below are land-use maps and aerial views of the terminals of this report. Also included are tables identifying berth characteristics.

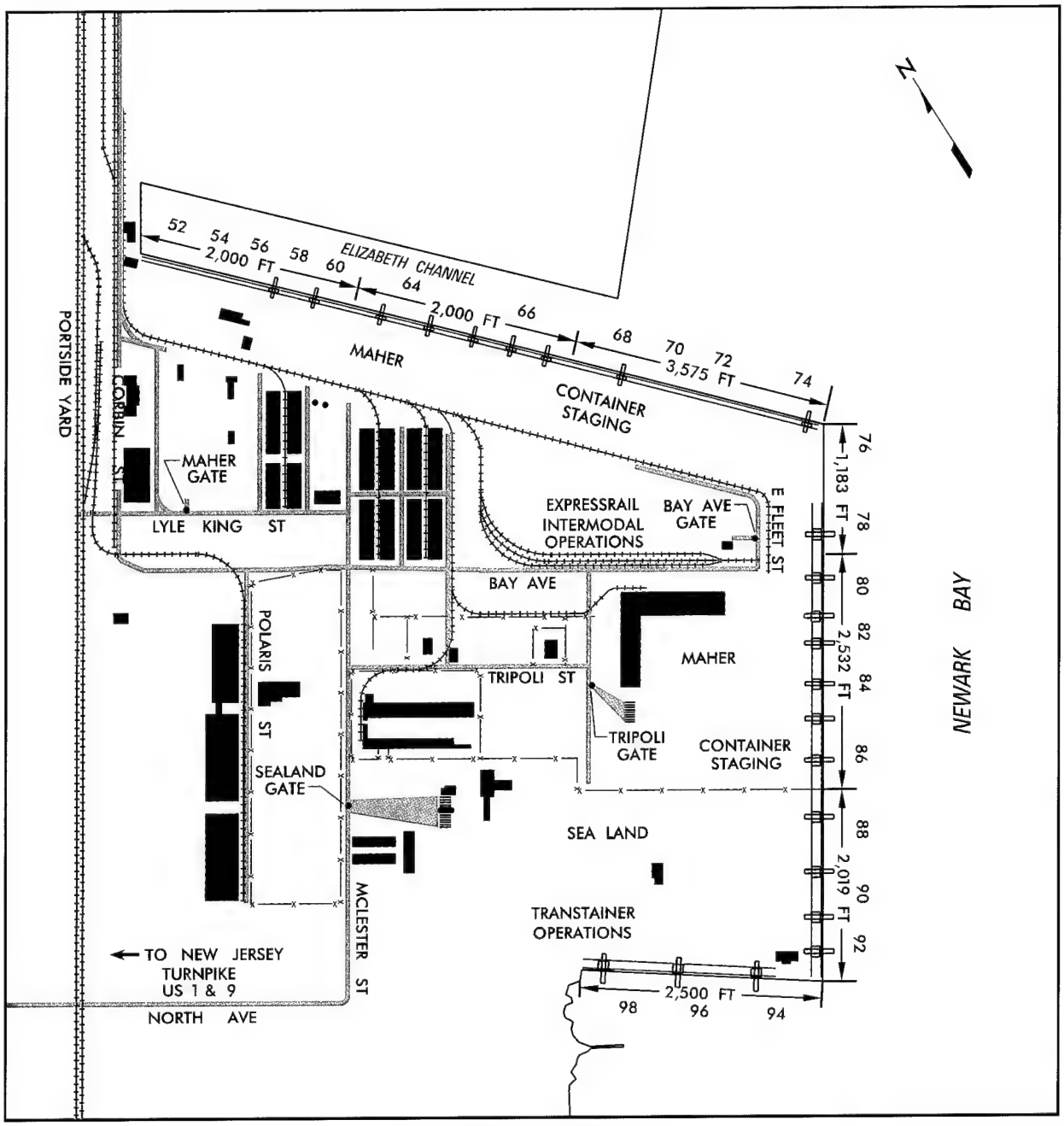


Port Newark Terminal

BERTHING CHARACTERISTICS OF PORT ELIZABETH TERMINAL							
Characteristics	**Berths**						
	52-60	**64-66**	**68-74**	**76-78**	**80-86**	**88-92**	**94-98**
Length (ft)	2,200	2,000	3,575	1,183	2,532	2.019	2,500
Depth alongside at MLW (ft)	35	35	35	38	38	38	40
Deck strength (psf)	500	500	500	500	500	500	500
Apron width (ft)	Open	Open	Open	Open	Open	Open	Open
Apron height above MLW (ft)	12	12	12	12	12	12	12
Number of container cranes	4	3	1	0	7	4	3
Number of wharf cranes	0	0	0	0	0	0	0
Apron lighting	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Straight-stern RORO facilities	Yes	No	No	No	No	No	No
Apron served by rail (ft)	300	1,700	0	0	0	0	0

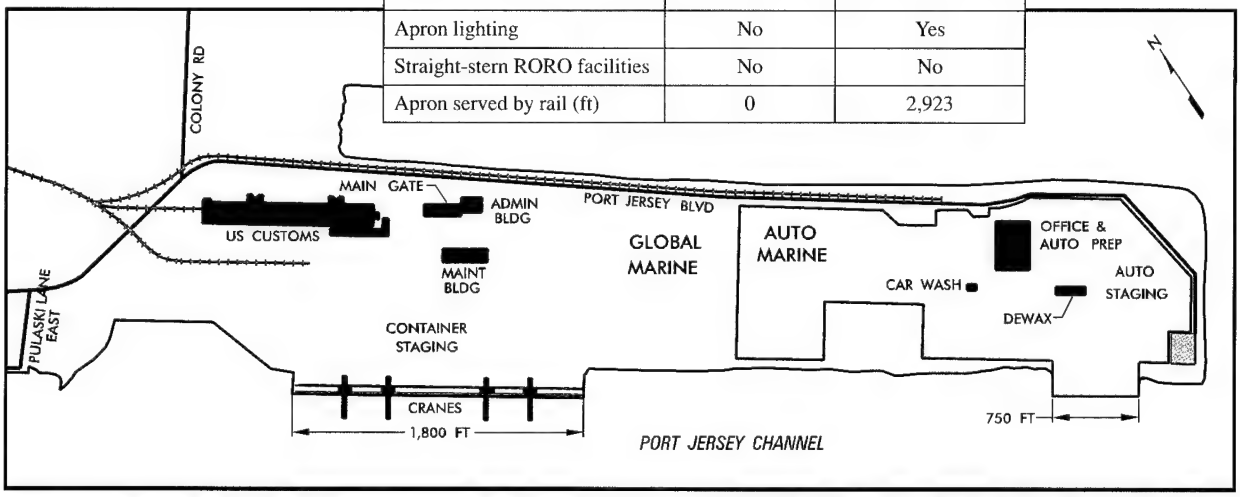


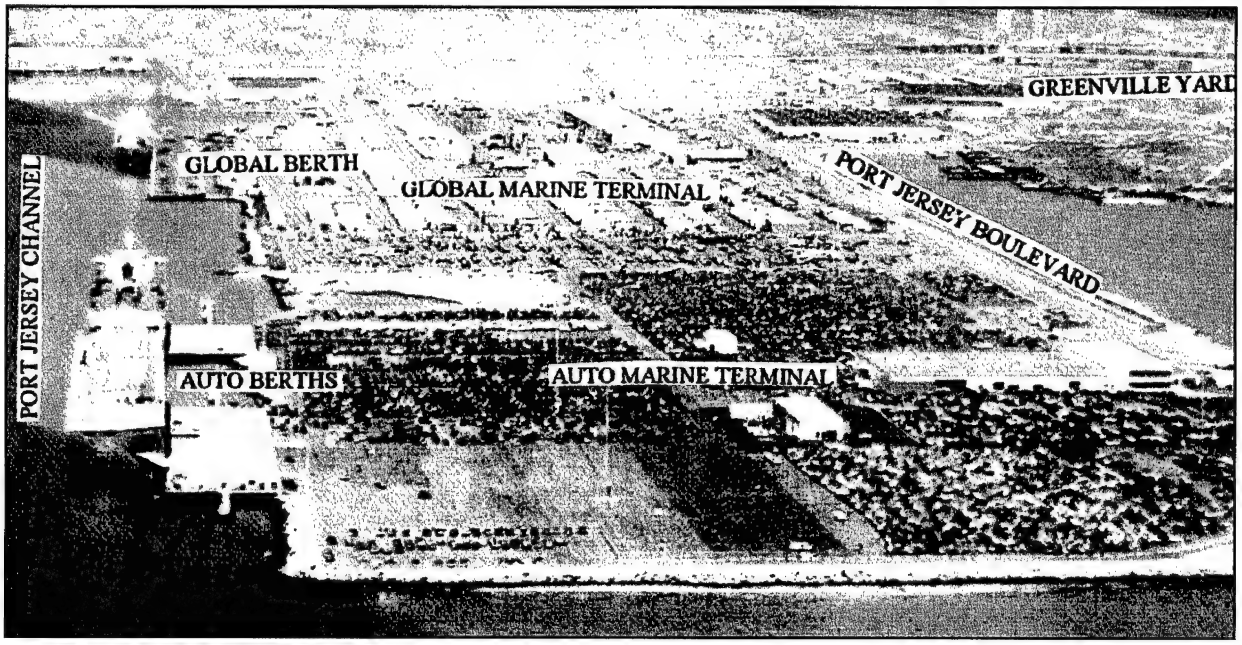
Port Elizabeth Terminal



Port Elizabeth Terminal

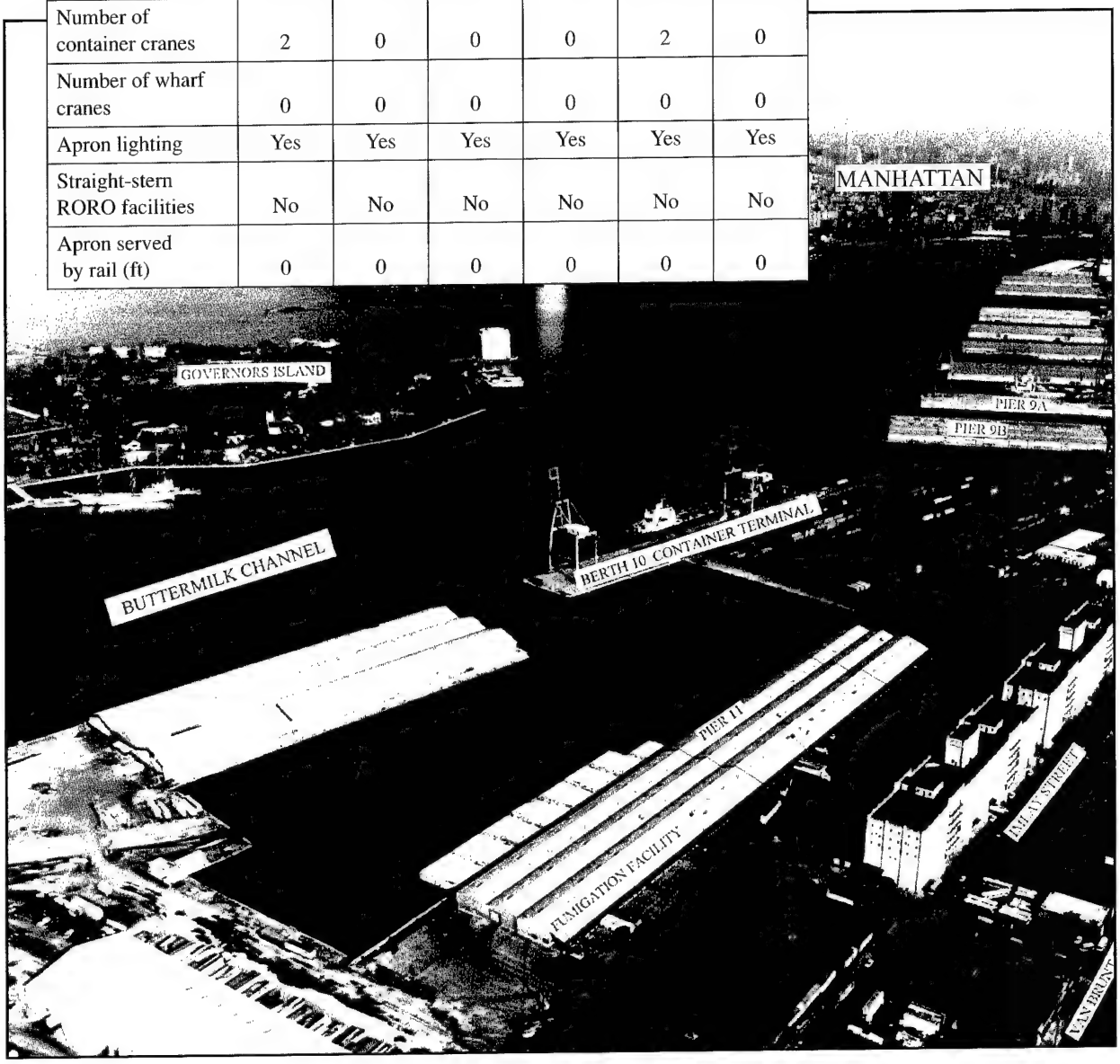
BERTHING CHARACTERISTICS OF GLOBAL MARINE AND AUTO MARINE TERMINALS		
Characteristics	**Terminal**	
	Auto Marine	**Global Marine**
Length (ft)	1,374	2,923
Depth alongside at MLW (ft)	35	35
Deck strength (psf)	500	500
Apron width (ft)	Open	56
Apron height above MLW (ft)	11	11
Number of container cranes	0	0
Number of wharf cranes	0	0
Apron lighting	No	Yes
Straight-stern RORO facilities	No	No
Apron served by rail (ft)	0	2,923



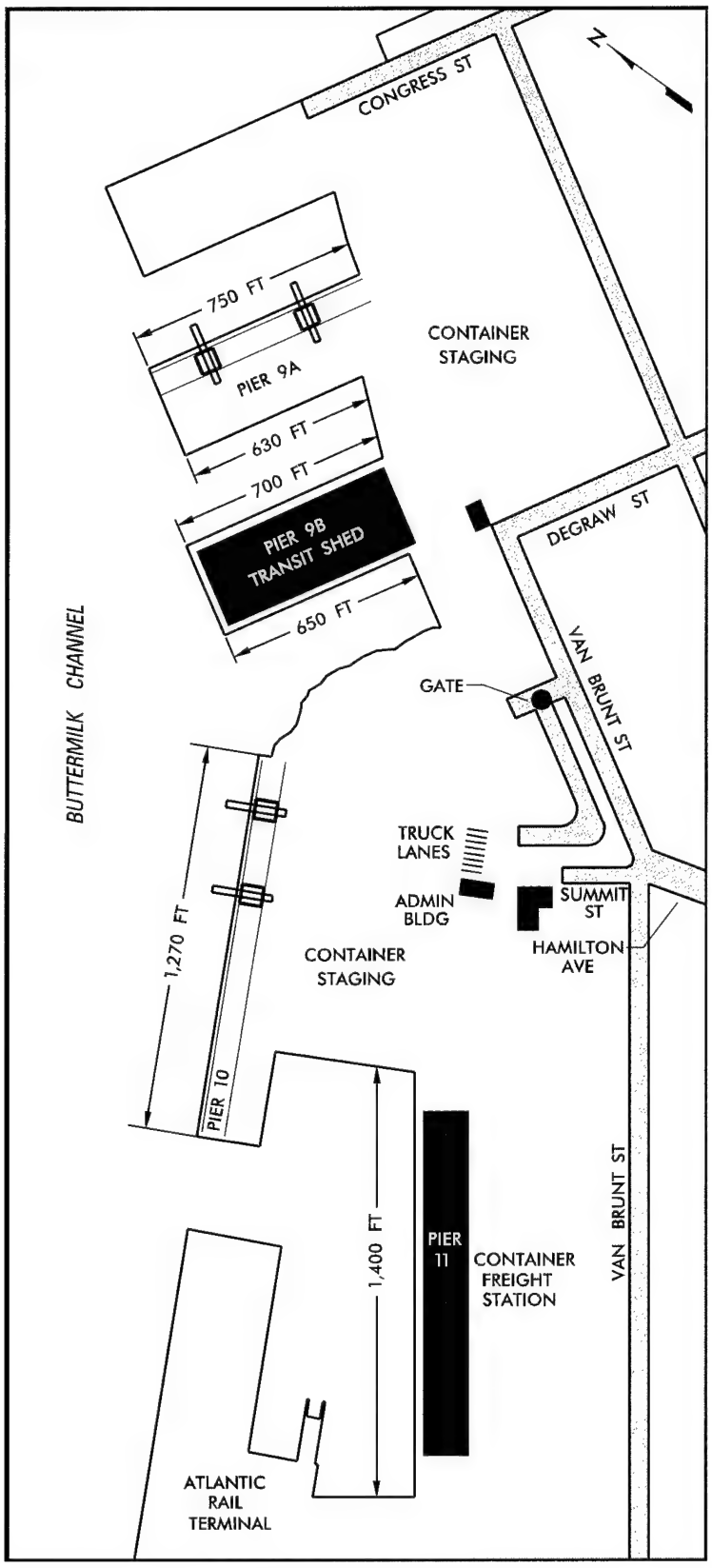


Global/Auto Marine Terminals
(Northwestward view)

BERTHING CHARACTERISTICS OF RED HOOK TERMINAL						
Characteristics	**Berths**					
	Pier 9A North	**Pier 9A South**	**Pier 9B North**	**Pier 9B South**	**Pier 10**	**Pier 11**
Length (ft)	750	630	700	650	1.270	1,400
Depth alongside at MLW (ft)	35	35	35	35	42	35
Deck strength (psf)	500	500	500	500	500	500
Apron width (ft)	Open	Open	30	30	Open	25
Apron height above MLW (ft)	12	12	12	12	12	12
Number of container cranes	2	0	0	0	2	0
Number of wharf cranes	0	0	0	0	0	0
Apron lighting	Yes	Yes	Yes	Yes	Yes	Yes
Straight-stern RORO facilities	No	No	No	No	No	No
Apron served by rail (ft)	0	0	0	0	0	0

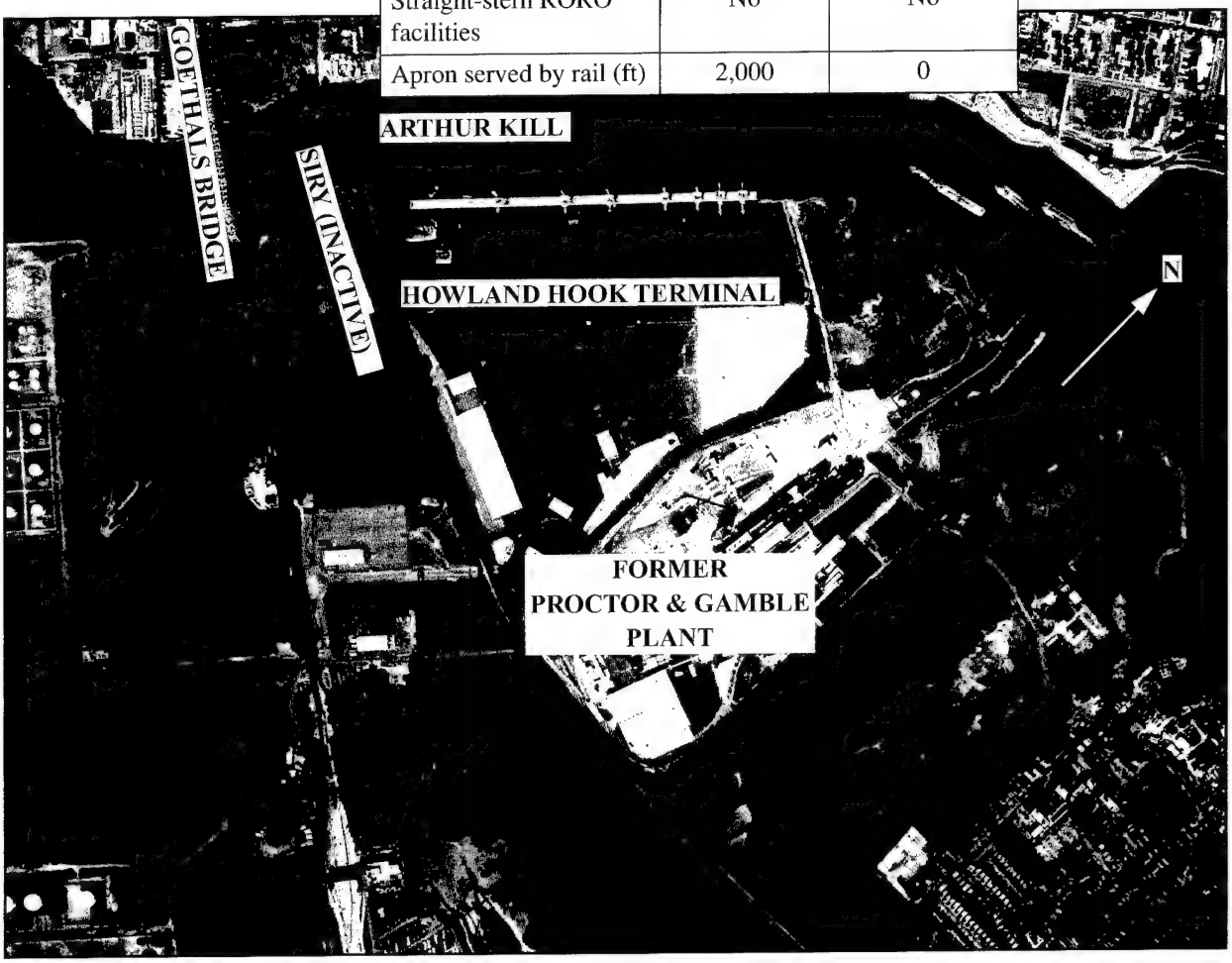


Red Hook Terminal (Northward view)

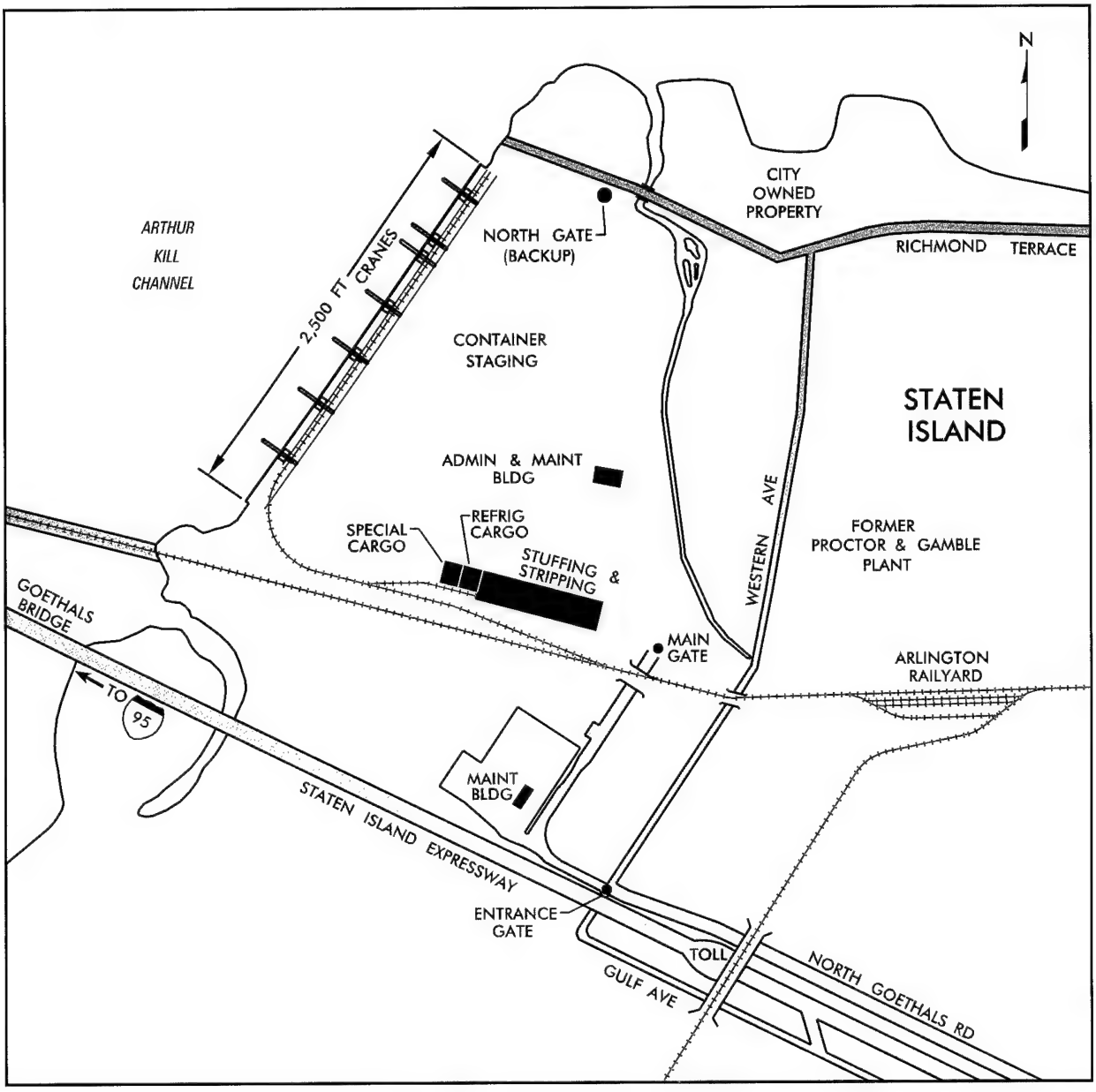


Red Hook Terminal

BERTHING CHARACTERISTICS OF HOWLAND HOOK TERMINAL		
Characteristics	**Berths**	
	1	**2**
Length (ft)	2,000	500
Depth alongside at MLW (ft)	40	35
Deck strength (psf)	500	500
Apron width (ft)	Open	Open
Apron height above MLW (ft)	12	12
Number of container cranes	7	0
Number of wharf cranes	0	0
Apron lighting	Yes	Yes
Straight-stern RORO facilities	No	No
Apron served by rail (ft)	2,000	0

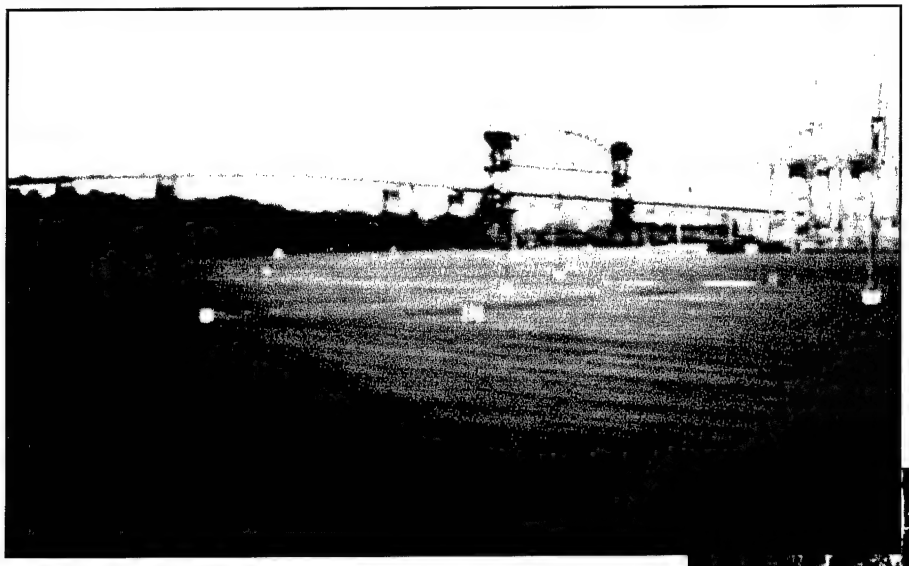


Howland Hook Terminal



Howland Hook Terminal

Staging



Open Staging at Howland Hook Terminal

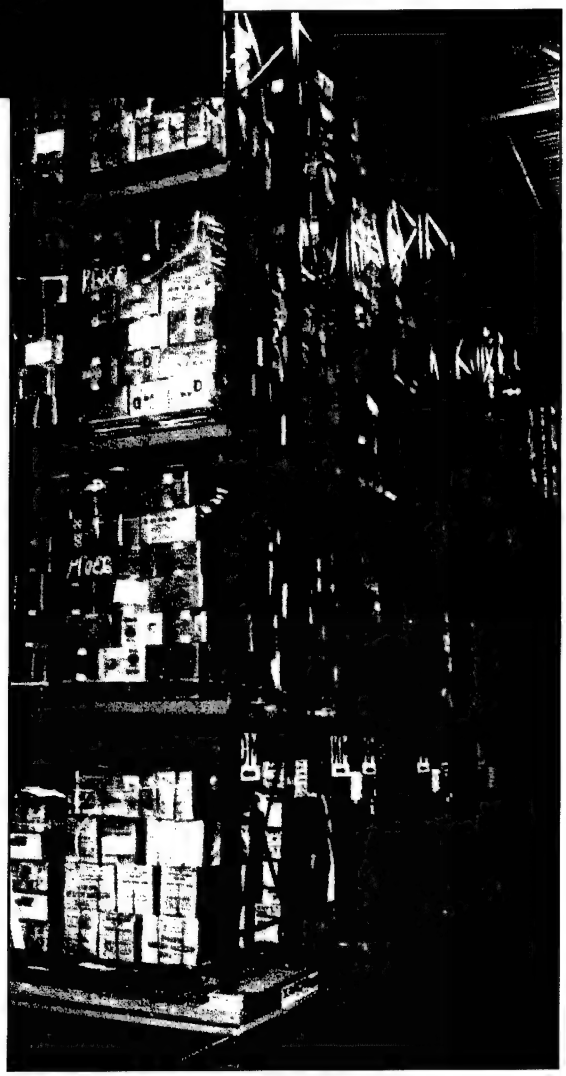
Open Staging

The terminals in this report have more than 1,100 acres of open staging. This land is used mainly for containers and vehicles.

Terminal	Open Staging (Acres)	Covered Staging (SQ FT)
Port Newark	240	3,100,000
Port Elizabeth	520	2,200,000
Global Marine	100	None
Auto Marine	143	100,000
Red Hook	70	340,000
Howland Hook	187	180,000

Covered Staging

The port has warehouse buildings throughout the terminals. All covered staging at the Global/Auto Marine Terminal is used for automobile processing and container stuffing.

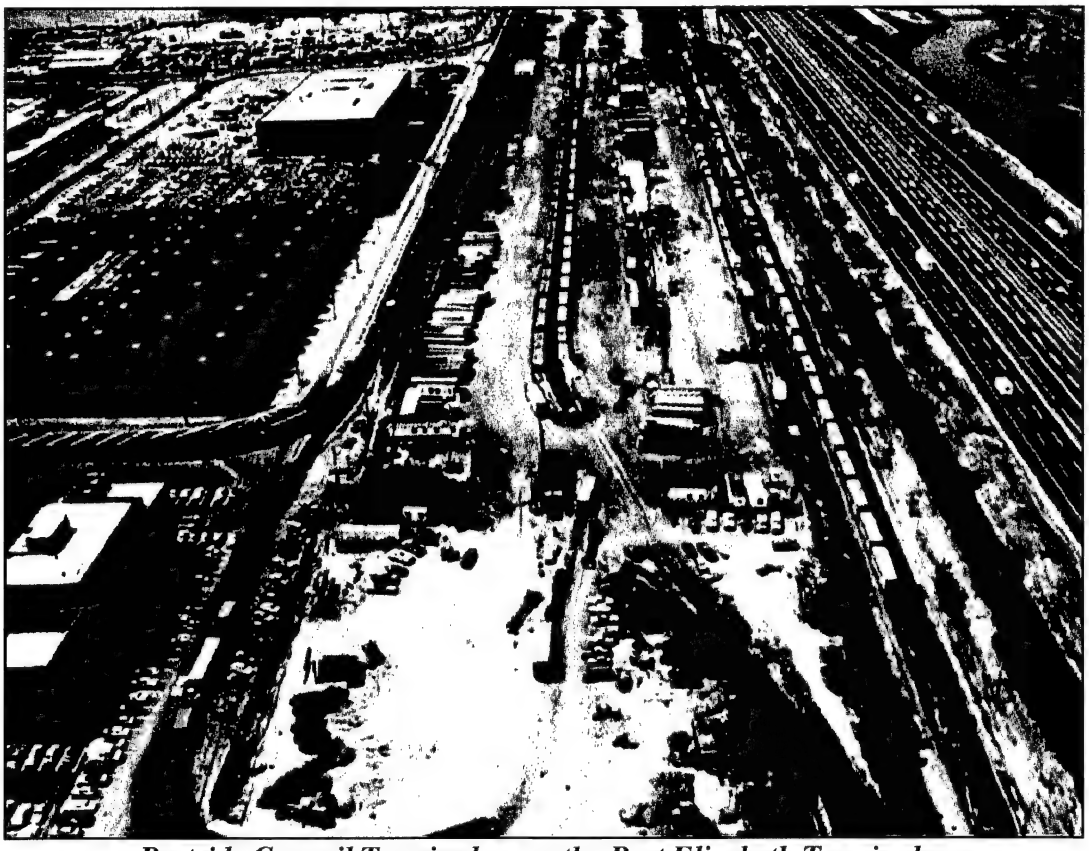


Covered Staging at Port Newark/Elizabeth Terminal

Rail

Rail trackage at Port Newark/Elizabeth links the railyards to the port's apron tracks, transit sheds, and storage tracks.

With 12 intermodal container transfer facilities, and the new ExpressRail terminal, the port has a vast capacity and fast turnaround.



Portside Conrail Terminal, near the Port Elizabeth Terminal

Unloading/Loading Positions

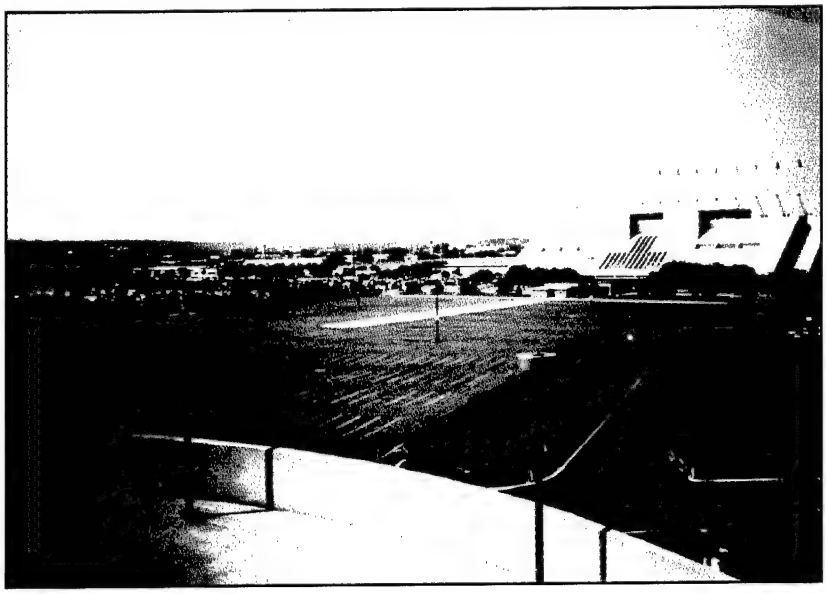
Ramps. The Port Authority has no portable or permanent rail end ramps. Plans should call for the military to bring or build ramps, or rent from local stevedore or equipment companies.

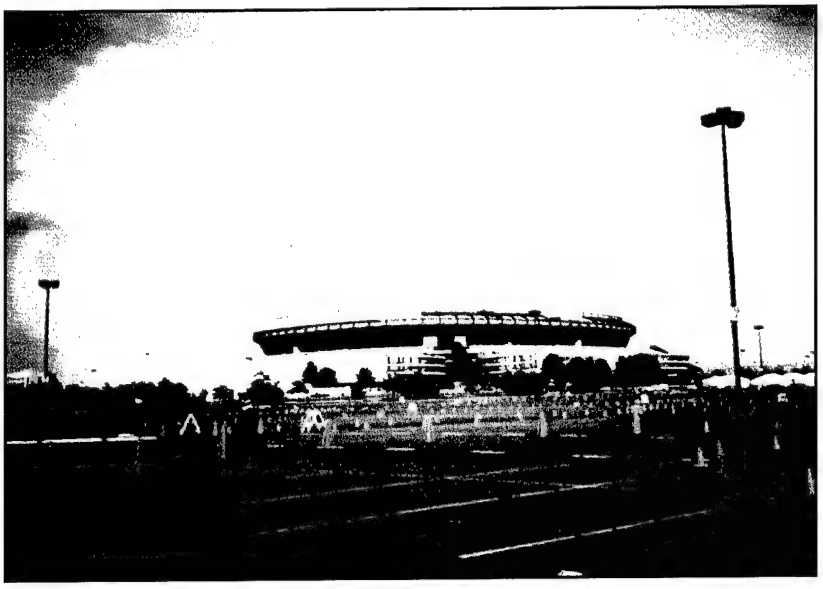
Docks. All covered storage facilities at the Port Newark/Elizabeth Terminal have boxcar and van handling positions. Several other buildings throughput the port also have boxcar and van handling positions.

Marshaling Areas

Within port. With the exception of the Howland Hook Terminal, there are no marshaling areas within or adjacent to the terminals. Howland Hook has over 50 acres of adjacent marshaling area. One area is an abandoned factory just inland of the terminal. Additional undeveloped land is east of the terminal.

Outside of Port. A possible marshaling area is about 10 miles north of the Port Newark/Elizabeth Terminal. The Meadowlands Sports Complex (home of the Giants Stadium) totals about 750 acres and has 24,500 parking spaces. This area is not likely to be available during football season. All lots have lighting and stormwater drainage.



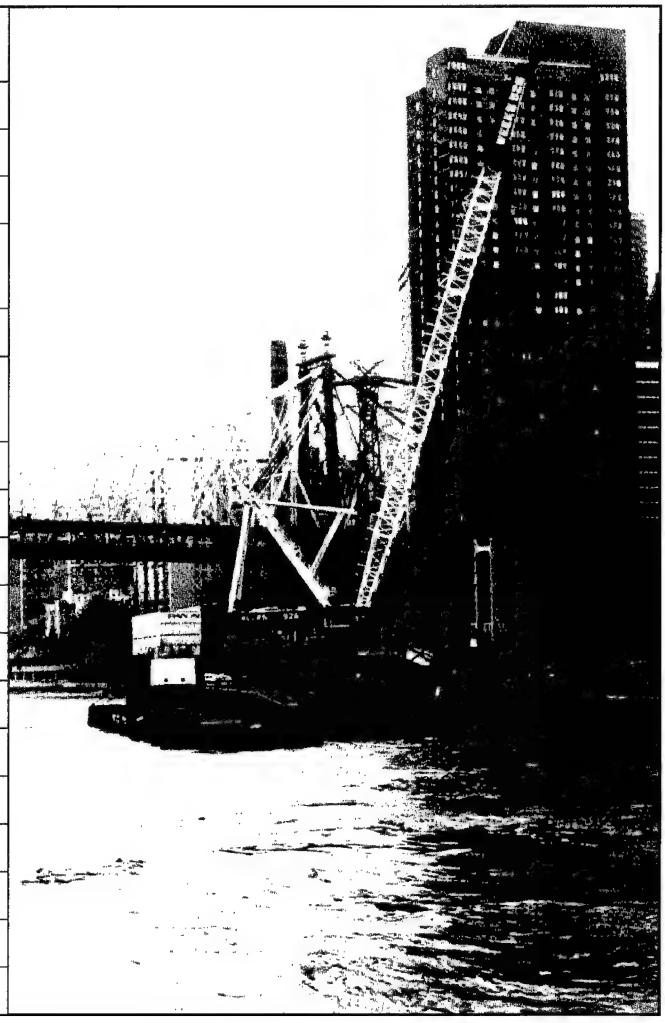


Two views of the Meadowlands Sports Complex, located north of the Port Newark/ Elizabeth Terminal

MATERIAL HANDLING EQUIPMENT (MHE)

The terminals have a total of 47 container cranes. These container cranes are located throughout the terminals and range in strength from 30 to 50 STON. Various shipping and rental companies in the area own transtainers and other MHE. This includes straddle carriers, truck cranes, Kalmar stackers, yard hustlers, top loaders, flatbeds, empty handlers, and a variety of forklifts. Mobile cranes with larger capacities are available from local stevedore companies. The nearby Weeks Marine Inc. and Don Jon Marine have a large supply of equipment that includes many types of barges, carfloats, hydraulic dredges, tugboats, floating cranes, heavy lift cranes, and other marine equipment.

TYPE OF EQUIPMENT	CAPACITY (STON)	QUANTITY
Port Newark/Elizabeth Terminal		
Stackers	5-30	6
Toploader	40	22
Clark Straddle Carrier	31	25
Ottawa Hustler	25-125	15
P&H Truck Crane	90	1
Global Marine Terminal		
Toploaders	30	4+
Sideloaders	8	4+
Auto Marine Terminal - no equipment		
Red Hook Terminal		
Yard Hustlers	-	4+
Sideloaders	8	2+
Top Handlers	45	2+
Howland Hook Terminal		
Toploaders	45	8
Sideloaders	8	2
Yard Hustlers	-	30



Weeks Marine Inc. Barge Crane

INTERMODAL FACILITIES

With daily help of the ExpressRail on-dock intermodal terminal, nearly centered in the Port Elizabeth Terminal, the rail connections link the port to any customer in the United States with speed, quality, and cost competitiveness.

There are 12 intermodal container transfer terminals near the port to allow large railcar capacity and quick turnaround. These rail facilities are shown on the rail access map in the beginning of this report.

FUTURE DEVELOPMENT

The New York/New Jersey metropolitan area is very highly developed. Only the Howland Hook Terminal has adjacent land for significant expansion. The Port Authority expects to extend the wharf of the Howland Hook Terminal northeastward another 1,000 feet into the adjacent undeveloped land. The inland abandoned Proctor & Gamble plant will likely be developed into paved open staging area to support Howland Hook as well.

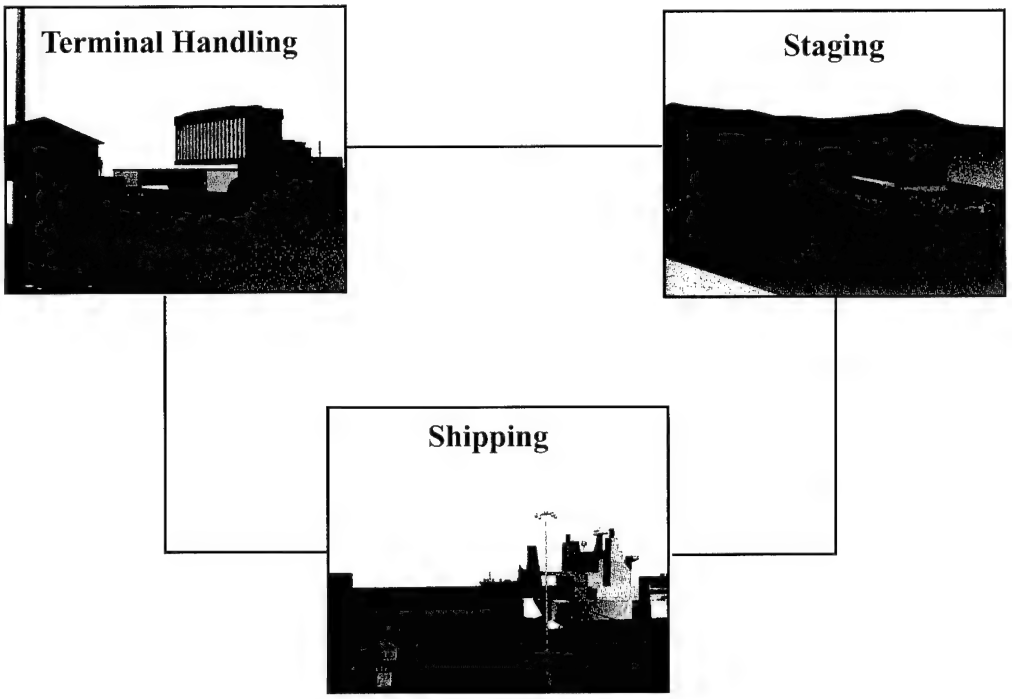
Environmental concerns have prevented the Port Authority from dredging to the full project depths, especially at the Port Newark/Elizabeth Terminals. Because of this, the many berths have silted to depths lower than those provided earlier in this report. Once proper permits are in place, the depths of this report will be restored. The Port Authority expects to resume dredging in 1996 or 1997.

The Military Ocean Terminal in Bayonne, New Jersey, is sighted for closure. At present, there are no firm plans for its commercial development.

II. THROUGHPUT ANALYSIS

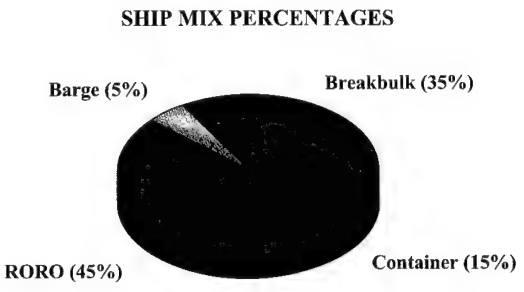
GENERAL

This section evaluates the throughput capability of the five selected terminals of the Port of New York and New Jersey. We determined the throughput capabilities using the port operational performance simulator (POPS) computer model. The model is based on a weak-link analysis in which each subsystem is analyzed separately and then compared to find the least capable subsystem. The weakest subsystem defines the maximum throughput capability of the terminal. The model yields throughput capability values for three subsystems - shipping, staging, and terminal processing/handling - in terms of measurement tons (MTON) per day.



Terminal Throughput Subsystems

This analysis assumes a maximum of 80 percent of the port facilities at each terminal can be made available at any one time. For this reason, we ran all port analyses using an 80 percent facility-use factor. Also, the ship mix is based on Desert Shield and Desert Storm statistics. We weighted the percentages to adjust for differences in cargo deadweights and expectations for future deployments.



RECEPTION/HANDLING

Highway

I-95, 278, and 78 provide access to the port. Each terminal has a designated entrance for trucks. The road network in and out of the terminals, including the gate processing of vehicles, could handle a total of about 2,200,000 MTON of equipment and supplies per day.

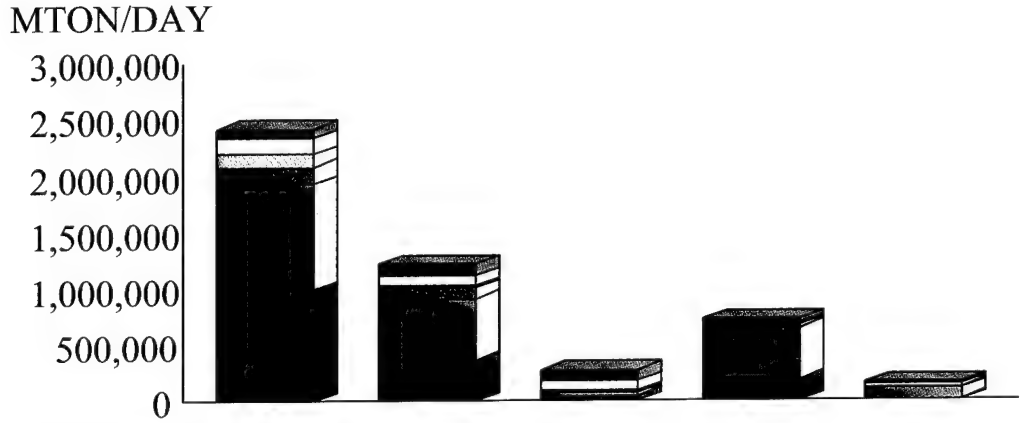
Roadable vehicles in convoys will process directly to the staging areas. Vehicles on commercial or military flatbed trailers without integral ramps will offload at portable ramps. We assume each terminal can support the portable truck ramps, truck docks, and here are no permanent truck end ramps at the port.

Truck Handling Facilities

Terminal	Portable Truck End Ramps	Van Handling Positions	Container Handlers
Port Newark	10	389	2
Port Elizabeth	6	1,021	20
Global Marine	None		
Auto Marine	2	77	2
Red Hook	2	28	8
Howland Hook	2	50	2

Supplies in van semitrailers will proceed to the van-handling positions at warehouses, transit sheds, and container freight stations.

HIGHWAY RECEPTION/HANDLING CAPABILITY



SUBSYSTEMS	HIGHWAY	GATES	END-RAMPS	DOCKS	CONTAINERS
PORT NEWARK	1,000,000	370,000	48,000	190,000	13,000
ELIZABETH	940,000	550,000	29,000	460,000	94,000
GLOBAL	150,000	95,000	9,600	34,000	11,000
AUTO	120,000	25,000	4,800	0	0
RED HOOK	140,000	87,000	96,000	18,000	33,000
HOWLAND HK	83,000	100,000	96,000	32,000	13,000

Rail

Rail reception at the port is one of the best on the east coast. The numerous intermodal yards and storage locations for railcars make the port very efficient. Conrail and the New York, Susquehanna and Western Railway provide trains to the port. The best rail service is at the Port Newark and Elizabeth Terminals due to their size, container operations, and on-site ExpressRail terminal.

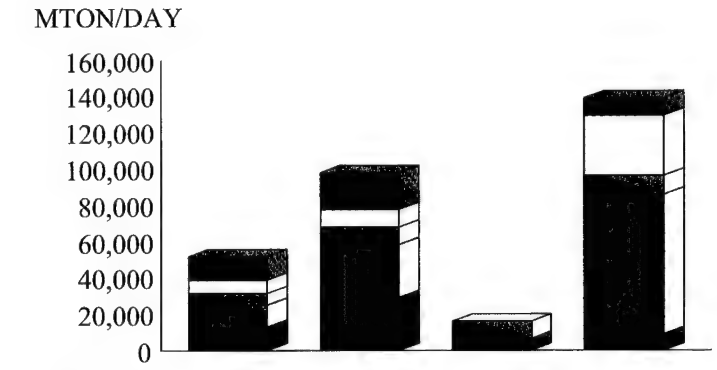
Red Hook does not have direct rail access. Rail operations for the Red Hook Terminal occur at the adjacent Atlantic Rail Terminal.

This analysis assumes the terminals can support the facilities as listed in the table below.

Rail Facilities

Terminal	Trains Per Day	Train Length (railcars)	Portable Ramps	Boxcar Docks	Container Handlers
Port Newark	2	60	3	62	2
Port Elizabeth	2	60	3	88	20
Global Marine	1	60	1	4	7
Auto Marine	None				
Red Hook	1	60	1	0	9
Howland Hook	2 (expected)	60	2	0	2

RAIL RECEPTION/HANDLING CAPABILITY



SUBSYSTEMS	TRACKAGE	END-RAMPS	DOCKS	COFC
PORT NEWARK	13,000	29,000	6,700	9,200
ELIZABETH	12,000	29,000	9,500	76,000
GLOBAL	7,000	9,600	430	11,000
AUTO	0	0	0	0
RED HOOK	7,200	9,900	0	33,000
HOWLAND HK	13,000	20,000	0	9,200

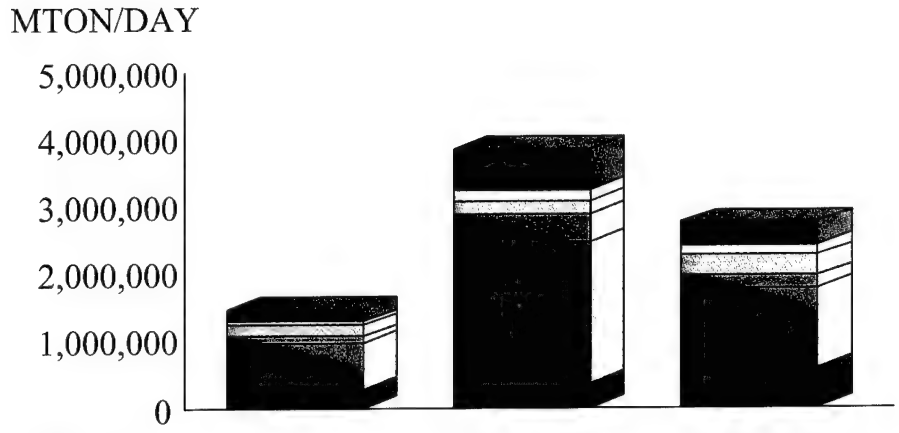
STAGING

The terminals of this report have a total of more than 1,000 acres of open paved staging. There is also over five million square feet of covered storage.

The terminal can perform operations on RORO, container, or breakbulk ships. The cargo mix depends on the anticipated vessel type. For example, cargo will be containerized if a containership is planned. The chart below provides the staging capability for the cargo for each of these vessel types. If a combination ship is expected, then a portion of each involved capability should be assumed.

Staging Facilities		
Terminal	**Open Staging (Acres)**	**Covered Staging (Sq Ft)**
Port Newark	240	3,100,000
Port Elizabeth	520	2,200,000
Global Marine	78	125,00027
Auto Marine	128	0
Red Hook	70	340,000
Howland Hook	146	200,000

OPEN STAGING CAPABILITY

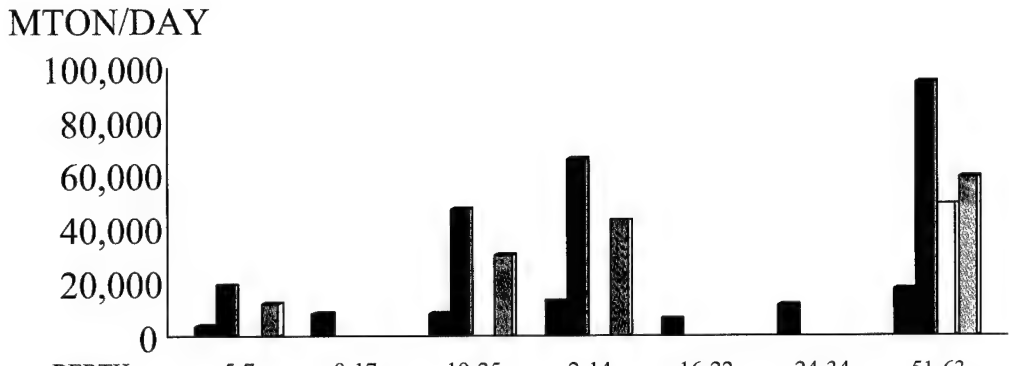


VESSEL TYPE	RORO	CONTAINERS	BREAKBULK
PORT NEWARK	270,000	350,000	570,000
ELIZABETH	690,000	2,100,000	1,200,000
GLOBAL	100,000	430,000	180,000
AUTO	170,000	180,000	300,000
RED HOOK	57,000	180,000	160,000
HOWLAND HK	180,000	610,000	340,000

SHIPPING

Throughputs for each berth are shown below. They are based on various factors including MHE utilized, loading, operational, and berth utilization rates as well as berth/ship compatibility.

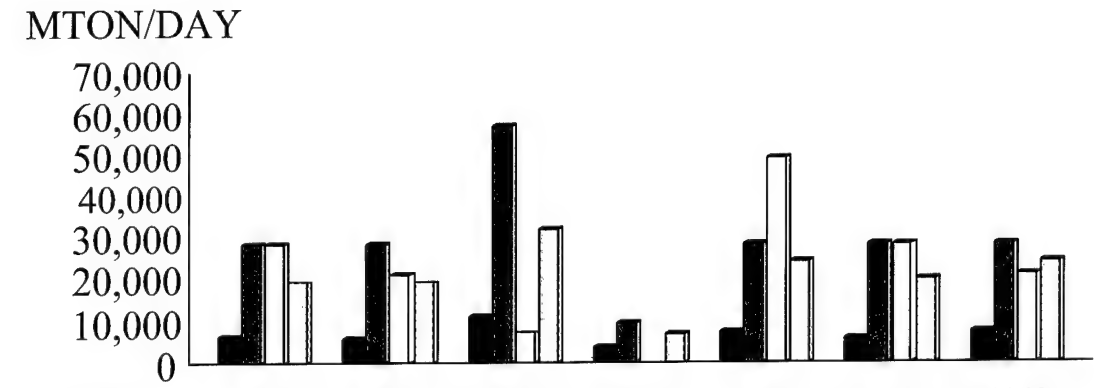
BERTH THROUGHPUT CAPABILITY
PORT NEWARK TERMINAL



BERTH	5-7	9-17	19-25	2-14	16-22	24-34	51-63
BREAKBULK	3,700	8,000	8,000	13,000	6,400	11,000	17,000
RORO	19,000	0	47,000	66,000	0	0	94,000
CONTAINER	0	0	0	0	0	0	49,000
MIXED	12,000	0	30,000	43,000	0	0	59,000

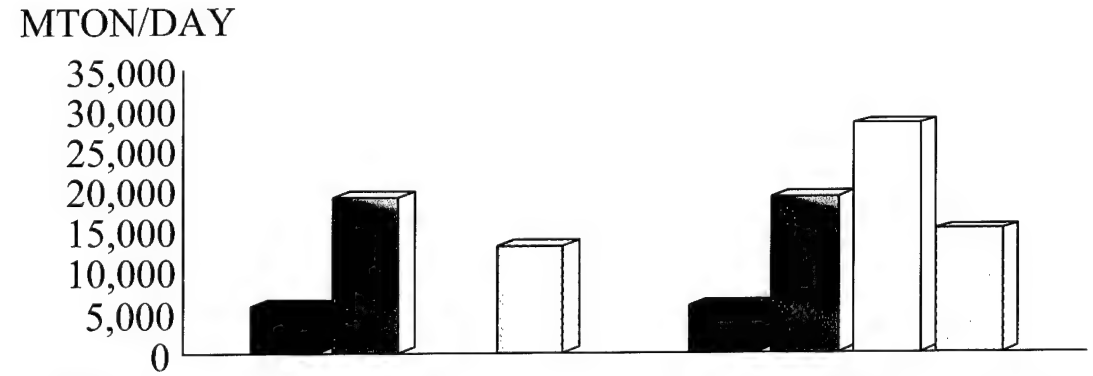
CONVERSION FACTORS	
Breakbulk	.4 STON per MTON
RORO	.25 STON per MTON
Containers	.4 STON per MTON

BERTH THROUGHPUT CAPABILITY
PORT ELIZABETH TERMINAL



BERTH	52-60	64-66	68-74	76-78	80-86	88-92	94-98
BREAKBULK	6,400	5,600	11,000	3,700	7,400	5,600	7,400
RORO	28,000	28,000	57,000	9,400	28,000	28,000	28,000
CONTAINER	28,000	21,000	7,000	0	49,000	28,000	21,000
MIXED	19,000	19,000	32,000	6,900	24,000	20,000	24,000

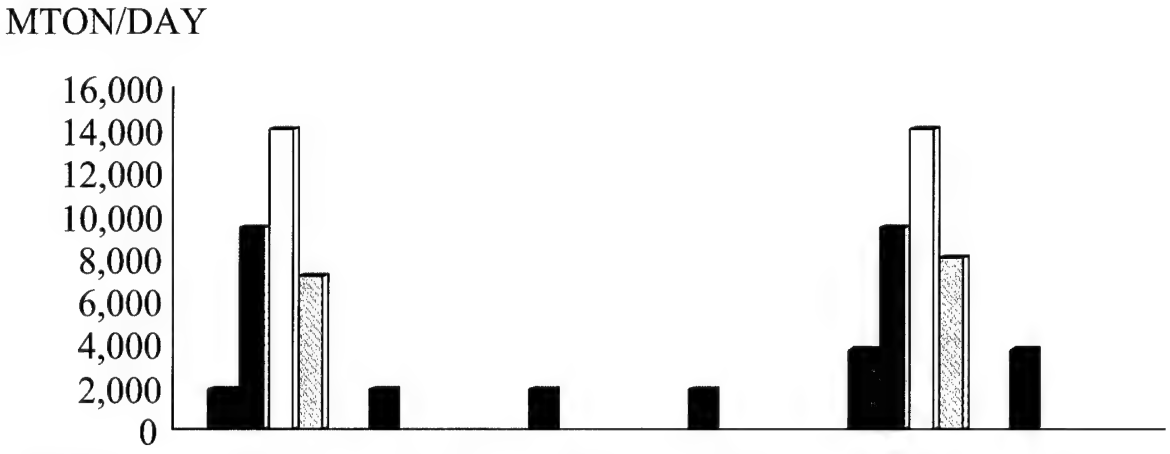
BERTH THROUGHPUT CAPABILITY
GLOBAL AND AUTO MARINE TERMINALS



BERTH	AUTO	GLOBAL
BREAKBULK	5,700	5,700
RORO	19,000	19,000
CONTAINER	0	28,000
MIXED	13,000	15,000

BERTH THROUGHPUT CAPABILITY

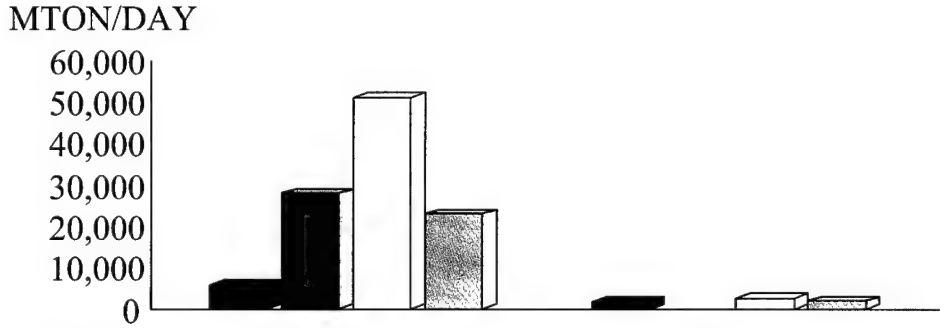
RED HOOK TERMINAL



BERTH	9A-N	9A-S	9B-N	9B-S	CONTR	11
BREAKBULK	1,900	1,900	1,900	1,900	3,700	3,700
RORO	9,400	0	0	0	9,400	0
CONTAINER	14,000	0	0	0	14,000	0
MIXED	7,100	0	0	0	8,000	0

BERTH THROUGHPUT CAPABILITY

HOWLAND HOOK TERMINAL



BERTH	HH-1	HH-2
BREAKBULK	5,700	1,700
RORO	28,000	0
CONTAINER	51,000	2,700
MIXED	23,000	2,000

The type of ship preferred at each berth is based on the methodology described in Appendix B. The evaluation is based on a snapshot view of the current physical characteristics of the berths and the MHE available. The lower the number for a berth, the better the berth is suitable for the loading operation.

We do not include the Auto Marine, Global Marine, and Howland Hook Terminals because they only have one berth.

Many of the berths are suited for FSS and LSMR operations. Those berths that are not capable of this type of loading have low water depth and/or apron obstructions.

PREFERENCE BERTH SELECTION			
BERTH	**BB**	**RORO**	**CNTNR**
Red Hook Terminal			
Pier 9A - North	5	2	2
Pier 9A - South	6	3	4
Pier 9B - North	2	-	-
Pier 9B - South	4	-	-
Pier 10	3	1	1
Pier 11	1	-	3

Note: Berths marked with a "-" are not recommended for these operations.

PREFERENCE BERTH SELECTION			
BERTH	**BB**	**RORO**	**CNTNR**
Port Newark/Elizabeth Terminal			
5-7	7	2	9
9-17	1	8	-
19-25	1	11	9
2-14	3	6	9
16-22	4	-	-
24-34	4	16	13
51-63	6	1	2
52-60	14	7	3
64-66	7	2	1
68-74	9	4	3
76-78	9	8	3
80-86	9	8	6
88-92	9	8	6
94-98	9	4	6

SUMMARY OF BERTHING CAPABILITIES OF PORT NEWARK TERMINAL

Vessel	Berths						
	5-7	9-17	19-25	2-14	16-22	24-34	51-63
Breakbulk							
C3-S-33a	2	5	5	8	4	7	10
C3-S-37c	2	5	5	7	4	7	10
C3-S-37d	2	5	5	7	4	7	10
C3-S-38a	2	5	5	8	4	7	10
C4-S-1a	2	4	4	7	3	6	9
C4-S-1qb and 1u	2	4	4	7	3	6	8
C4-S-58a	2	4	4	6	3	6	8
C4-S-65a	2	4	4	7	3	6	9
C4-S-66a	2	5	4	7	3	7	9
C4-S-69b	2	4	4	6	3	6	8
Seatrain							
GA and PR-class	2	4	4	7	3	6	9
Barge							
LASH C8-S-81b	1	3	3	4	2	4	6
LASH C9-S-81d	a	a	a	a	a	a	a
LASH lighter	9	20	19	29	15	28	37
SEABEE C8-S-82a	a	a	a	a	a	a	a
SEABEE barge	6	14	13	20	10	20	26
RORO							
Comet	2,d,i	d,o	5,d,i	7,d,i	d,o	d,o	10,d,i
C7-S-95a/Maine-class	1	b	3	5	b	b	6
Ponce-class	h	b,h	h	h	b,h	b,h	h
Great Land-class	h	b,h	h	h	b,h	b,h	h
Cygnus/Pilot-class	2	b	4	6	b	b	8
Meteor	d,i,j	d,o	d,i,j	d,i,j	d,o	d,o	d,i,j
AmEagle/Condor	2,i	b	4,i	6,i	b	b	8,i
MV Ambassador	d	d	d	d	d	d	d
FSS-class	1	b	2	4	b	b	5
Cape D-class	1,i	b	3,i	5,i	b	b	7,i
Cape H-class	a	a,b	a	a	a,b	a,b	6
LMSR	1	b	2	4	b	b	5
Container							
C6-S-lw	2,e	4,e	4,e	6,e	3,e	5,e	7
C7-S-68e	1,e	4,e	3,e	5,e	2,e	5,e	7
C8-S-85c	1,e	3,e	3,e	4,e	2,e	4,e	6
Combination							
C5-S-78a	2,e	4,e	4,e	6,e	3,e	6,e	8
C5-S-37e	2,e	4,e	4,e	6,e	3,e	6,e	8

a=vessel draft limited to berth depth
b=inadequate apron width
c=inadequate berth length
d=no straight stern-ramp facilities
e=no container-handling equipment
f=shallow berth, adequate anchorage depth
g=inadequate channel depth
h=no shore-based ramps available
i=insufficient ramp clearance at low tide
j=insufficient ramp clearance at high tide
k=excessive ramp angle at low tide
m=excessive ramp angle at high tide
n=parallel ramp operation only
o=too narrow apron for side-ramp

Notes: Ramp clearance and ramp angle based on maximum vessel draft
( ) indicates vessels assigned by analyst

SUMMARY OF BERTHING CAPABILITIES OF PORT ELIZABETH TERMINAL

Vessel	Berths						
	52-60	64-66	68-74	76-78	80-86	88-92	94-98
Breakbulk							
C3-S-33a	4	3	4	2	4	3	4
C3-S-37c	4	3	4	2	4	3	4
C3-S-37d	4	3	4	2	4	3	4
C3-S-38a	4	3	4	2	4	3	4
C4-S-1a	3	3	3	2	4	3	4
C4-S-1qb and 1u	3	3	3	2	4	3	4
C4-S-58a	3	3	3	1	4	3	4
C4-S-65a	3	3	3	2	4	3	4
C4-S-66a	3	3	4	2	4	3	4
C4-S-69b	3	3	3	1	4	3	4
Seatrain							
GA and PR-class	3	3	3	2	4	3	4
Barge							
LASH C8-S-81b	2	2	2	1	2	2	2
LASH C9-S-81d	a	a	2	1	2	2	2
LASH lighter	15	14	16	8	18	14	17
SEABEE C8-S-82a	a	a	2	1	2	2	2
SEABEE barge	11	10	11	5	12	10	12
RORO							
Comet	i,j	d,i,j	i,j	d,i,j	d,i,j	d,i,j	i,j
C7-S-95a/Maine-class	2	2	2	1	3	2	3
Ponce-class	h	h	h	h	h	h	h
Great Land-class	h	h	h	h	h	h	h
Cygnus/Pilot-class	3	3	3	1	3	3	3
Meteor	i,j	d,i,j	i,j	d,i,j	d,i,j	d,i,j	i,j
AmEagle/Condor	i,j	i,j	i,j	i,j	i,j	i,j	i,j
MV Ambassador	3,m	d	3,m	d	d	d	4,m
FSS-class	2	2	2	1	2	2	2
Cape D-class	1,j	i,j	i,j	i,j	i,j	i,j	i,j
Cape H-class	a	a	2	1	3	2	3
LMSR	2	2	2	1	2	d	2
Container							
C6-S-lw	3	2	3	1	3	2	3
C7-S-68e	3	2	3	1	3	2	3
C8-S-85c	2	2	2	1	2	2	2
Combination							
C5-S-78a	3	3	3	1	4	3	3
C5-S-37e	3	3	3	1	4	3	4

a=vessel draft limited to berth depth
b=inadequate apron width
c=inadequate berth length
d=no straight stern-ramp facilities
e=no container-handling equipment
f=shallow berth, adequate anchorage depth
g=inadequate channel depth
h=no shore-based ramps available
i=insufficient ramp clearance at low tide
j=insufficient ramp clearance at high tide
k=excessive ramp angle at low tide
m=excessive ramp angle at high tide
n=parallel ramp operation only
o=too narrow apron for side-ramp

Notes: Ramp clearance and ramp angle based on maximum vessel draft
( ) indicates vessels assigned by analyst

SUMMARY OF BERTHING CAPABILITIES OF RED HOOK, GLOBAL MARINE, AND AUTO MARINE TERMINALS

Vessel	Berths							
	RH PIER 9A-N	RH PIER 9A-S	RH PIER 9B-N	RH PIER 9B-S	RH PIER 10	RH PIER 11	GLOBAL	AUTO
Breakbulk								
C3-S-33a	1	1	1	1	2	2	3	3
C3-S-37c	1	1	1	1	2	2	3	3
C3-S-37d	1	1	1	1	2	2	3	3
C3-S-38a	1	1	1	1	2	2	3	3
C4-S-1a	1	1	1	1	2	2	3	3
C4-S-1qb and 1u	1	1	1	1	2	2	3	3
C4-S-58a	1	1	1	1	2	2	3	3
C4-S-65a	1	1	1	1	2	2	3	3
C4-S-66a	1	1	1	1	2	2	3	a
C4-S-69b	1	1	1	1	2	2	2	2
Seatrain								
GA and PR-class	1	1	1	1	2	2	3	3
Barge								
LASH C8-S-81b	c	c	c	c	1	1	2	a,f
LASH C9-S-81d	a,c,g	a,c,g	a,c,g	a,c,g	g	a,g	g	a,g
LASH lighter	5	4	5	4	9	10	12	12
SEABEE C8-S-82a	a,c,g	a,c,g	a,c,g	a,c,g	g	a,g	g	a,g
SEABEE barge	3	3	3	3	6	7	9	9
RORO								
Comet	d,i,j	d,i,j	d,o	d,o	d,i,j	d,o	d,i,j	d,i,j
C7-S-95a/Maine-class	1	c	b,c	b,c	1	b	2	a
Ponce-class	h	c,h	b,h	b,c,h	h	b,h	h	h
Great Land-class	c,h	c,h	b,c,h	b,c,h	b	b,h	h	h
Cygnus/Pilot-class	1	c	b	b	1	b	2	2
Meteor	d,i,j	d,i,j	d,o	d,o	d,i,j	d,o	d,i,j	d,i,j
AmEagle/Condor	i,j	c	b	b	i,j	b	i,j	i,j
MV Ambassador	d	d	d	d	d	d	d	d
FSS-class	c	c	b,c	b,c	1	b	1	a
Cape D-class	i,j	c	b	b,c	i,j	b	i,j	a
Cape H-class	a	a,c	a,b,c	a,b,c	1	a,b	2	a
LMSR	c	c	b.c	b,c	1	b	1	9
Container								
C6-S-lw	1	c,e	1,e	c,e	1	2,e	2	2,e
C7-S-68e	1	c,e	c,e	c,e	1	1,e	2	2,e
C8-S-85c	c	c,e	c,e	c,e	1	1,e	2	a,e
Combination								
C5-S-78a	1	1,e	1,e	1,e	2	2,e	2	a,e
C5-S-37e	1	1,e	1,e	1,e	2	2,e	2	2,e

a=vessel draft limited to berth depth
b=inadequate apron width
c=inadequate berth length
d=no straight stern-ramp facilities
e=no container-handling equipment
f=shallow berth, adequate anchorage depth
g=inadequate channel depth
h=no shore-based ramps available
i=insufficient ramp clearance at low tide
j=insufficient ramp clearance at high tide
k=excessive ramp angle at low tide
m=excessive ramp angle at high tide
n=parallel ramp operation only
o=too narrow apron for side-ramp

Notes: Ramp clearance and ramp angle based on maximum vessel draft
( ) indicates vessels assigned by analyst

SUMMARY OF BERTHING CAPABILITIES OF HOWLAND HOOK TERMINAL

Vessel	Berths	
	How Hk-1	How Hk-2
Breakbulk		
C3-S-33a	3	1
C3-S-37c	3	1
C3-S-37d	3	1
C3-S-38a	3	1
C4-S-1a	3	c
C4-S-1qb and 1u	3	c
C4-S-58a	3	c
C4-S-65a	3	c
C4-S-66a	3	c
C4-S-69b	3	c
Seatrain		
GA and PR-class	3	c
Barge		
LASH C8-S-81b	2	c
LASH C9-S-81d	2	a,c
LASH lighter	14	3
SEABEE C8-S-82a	2	a,c
SEABEE barge	10	2
RORO		
Comet	d,i,j	d,i,j
C7-S-95a/Maine-class	2	c
Ponce-class	h	c,h
Great Land-class	h	c,h
Cygnus/Pilot-class	3	c
Meteor	d,i,j	c,d
AmEagle/Condor	i,j	c
MV Ambassador	d	c,d
FSS-class	2	c
Cape D-class	i,j	c
Cape H-class	2	a,c
LMSR	2	c
Container		
C6-S-1w	2	c,e
C7-S-68e	2	c,e
C8-S-85c	2	c,e
Combination		
C5-S-78a	3	c,e
C5-S-37e	3	c,e

a=vessel draft limited to berth depth
b=inadequate apron width
c=inadequate berth length
d=no straight stern-ramp facilities
e=no container-handling equipment
f=shallow berth, adequate anchorage depth
g=inadequate channel depth
h=no shore-based ramps available
i=insufficient ramp clearance at low tide
j=insufficient ramp clearance at high tide
k=excessive ramp angle at low tide
m=excessive ramp angle at high tide
n=parallel ramp operation only
o=too narrow apron for side-ramp

Notes: Ramp clearance and ramp angle based on maximum vessel draft
( ) indicates vessels assigned by analyst

III. APPLICATION

GENERAL

This section will evaluate the port's throughput capability for deploying a notional mechanized infantry division using primarily FSS vessels. In January 1996, MARAD and the Port Authority of New York/New Jersey agreed on planning orders as shown below.

Planning Order Facilities					
Terminal	**Berthing Space (ft)**	**Open Staging (acres)**	**Warehouse Space (sq ft)**	**Covered Maintenance Area (sq ft)**	**Administration Space (sq ft)**
Howland Hook	1,000	35	80,000	2,900	2,500
Port Newark/Elizabeth	1,000 at berth 96	35	80,000	2,900 in Bldg 5000	2,500

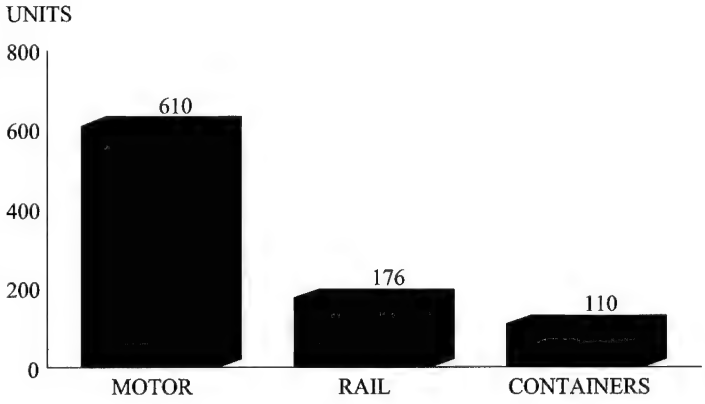
REQUIREMENTS

This analysis assumes the requirement for the Port of New York and New Jersey is to deploy a notional mechanized infantry division in 6 days of reception and throughput. The division has to move about 7,800 vehicles and 660 containers. The movement to the port will require 1,055 (176 per day) railcars using the convoy/rail option. Under this option, about 3,650 (610 per day) roadable vehicles would be driven and about 2,320 (387 per day) would be towed.

Total Equipment	
Volume	280,000 MTON
Weight	95,000 STON
Area	1,400,000 SQ FT
Vehicles	7,800
Containers	660

MECHANIZED INFANTRY DIVISION

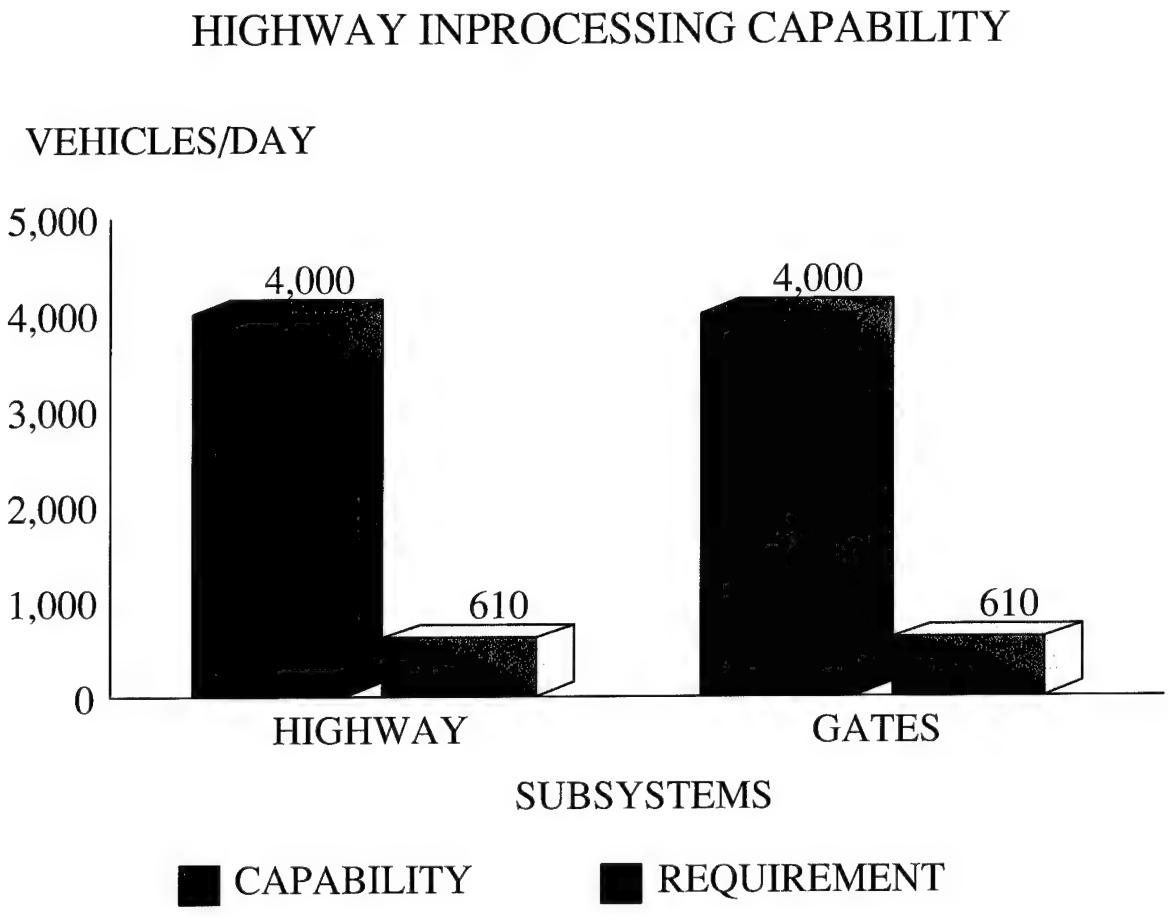
DAILY REQUIREMENTS



TERMINAL INPROCESSING/HANDLING

Highway

Although four bridges access Staten Island, we assume military vehicles will cross the Goethals Bridge, just outside the Howland Hook Terminal. From there, vehicles would enter one of several gates, depending on the congestion at the terminal. Military vehicles would likely enter the Sea-Land section (berth 96) of the Port Elizabeth Terminal via McLester Street. The access roads and gates to both terminals together can handle well over 4,000 vehicles per day.



Rail

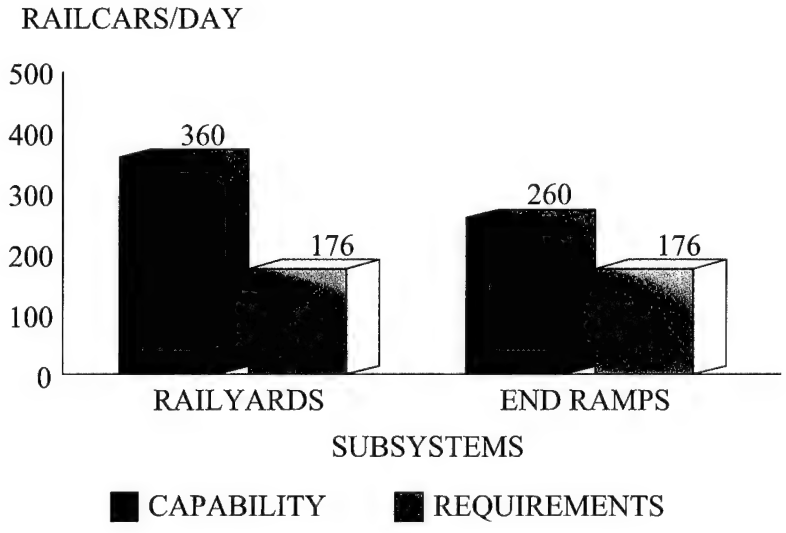
At present the rail capability of the Howland Hook Terminal is uncertain. Access from the Conrail line in New Jersey to Staten Island has been inactive for several years. MTMC believes the rail line will be restored to meet the DoD clearance and weight requirements, in late 1996 or 1997. Once rail access is fully restored, the Howland Hook Terminal and the Arlington Railyard on Staten Island could together receive more than 120 railcars per day.

The railyards in and around the Port Newark and Elizabeth Terminals can receive about 240 railcars of military equipment per day. This capacity along with the capacity on Staten Island is sufficient to meet the requirement.

The only location at the Howland Hook Terminal that can support rail offloading is along the wharf, just inland of the container cranes. Placing a portable or temporary rail end ramp at the end of each of the two spurs, and conducting four switching cycles per day, would offload about 160 railcars per day. The MTMC port operator should insure the rail offloading operations leave access to the shiploading area. If necessary. the container cranes could be used for direct loading from the railcars to the ship.

The land-use map for the Port Elizabeth Terminal shows numerous rail spurs that might support flatcar offloading. This analysis assumes the tracks along the warehouses at the north end of terminal will be available. Two portable or temporary rail end ramps at these spurs can support offloading a total of about 25 railcars at the same time. Assuming four cycles per day, these ramps could offload about 100 railcars per day. These ramps and those at the Howland Hook Terminal could offload a total of about 260 railcars per day. This capability meets the requirement.

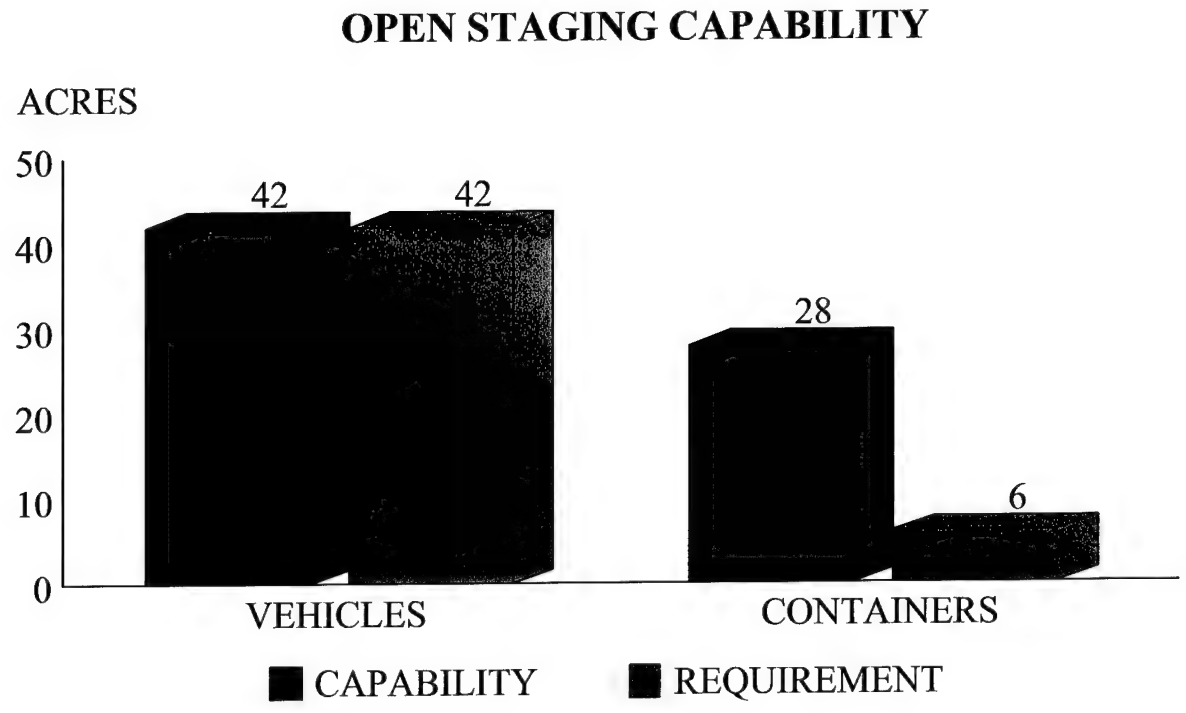
RAIL INPROCESSING AND HANDLING CAPABILITY



STAGING

This analysis assumes that current downsizing continues, and that nine FSS-sized ships will deploy an entire notional mechanized infantry division. Three ships will depart every 2 days. Because of this, the staging requirement is to support three sustained loading operations, two at the Howland Hook Terminal and one at berth 96 of the Port Elizabeth Terminal (Sea-Land).

Although an FSS load of cargo can be staged and loaded on 10 acres, 16 acres are required for sustained loading operations. Of these 16 acres, about 2 acres are required for staging the 73 containers for each FSS. The three simultaneous shiploading operations will require 48 acres of open staging, of which about 6 acres are dedicated to containers. This analysis assumes the military will use 32 acres at the Howland Hook Terminal, and 16 acres at the Port Elizabeth Terminal (berth 96). The Planning Orders allocates 35 acres to the Howland Hook Terminal and another 35 to the Port Elizabeth Terminal. This exceeds the requirement.



SHIPPING

Although this analysis assumes that only nine FSS-sized ships can deploy the notional mechanized infantry division. The number of ships required depends on the shipping mix selected. The best ship mix would consist of all eight FSS ships, plus two Cape H RORO ships.

The requirement is to berth two FSS-sized vessels at the Howland Hook Terminal, and one at berth 96 of the Port Elizabeth Terminal. The Berthing Capabilities tables earlier in this report show the port has over 25 berths capable of supporting FSS operations. Most of these are at the Port Newark/Elizabeth Terminal. The Planning Orders, however, only provide for two FSS berths; one at Howland Hook and one at berth 96 of the Port Elizabeth Terminal. This does not meet the requirement

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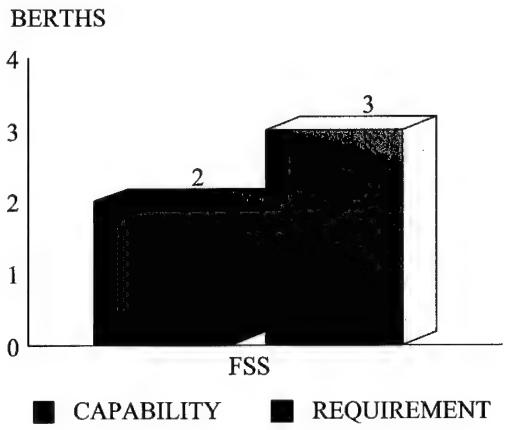
FSS SHIPPING CAPABILITY



UNIT MOVEMENT REQUIREMENTS
MECHANIZED DIVISION

Loading Condition/Sample Ship Mix	Vessel Types			
	FSS (RORO Comb)	Cape H (RORO Comb)	C3/C4 (Breakbulk)	C6/C7/C8 (Container)
Minimum Containerization:				
All FSS*	8.00	1.90		
FSS and Cape H	6.64	3.00		
All Breakbulk			37.70	
Maximum Containerization				
FSS and Container	7.90			2.00
FSS, Cape H, and Container	7.90			2.00
Breakbulk and Container			29.58	2.00

* Only eight FSS vessels are currently available. Unit shipping requirements exceed the capacity of these eight vessels. Other vessel types are required to makeup the shortfall (Cape H or upcoming LMSR).

Legend:
RORO - roll on/roll off
FSS - fast sealift ship

Source: MTMCTEA Report OA 90-4f-22, Deployment Planning Guide. Aug 91

SUMMARY

The port can easily support the deployment of the division. The Planning Orders, however, do not allow for enough berthing space.

RECOMMENDATION

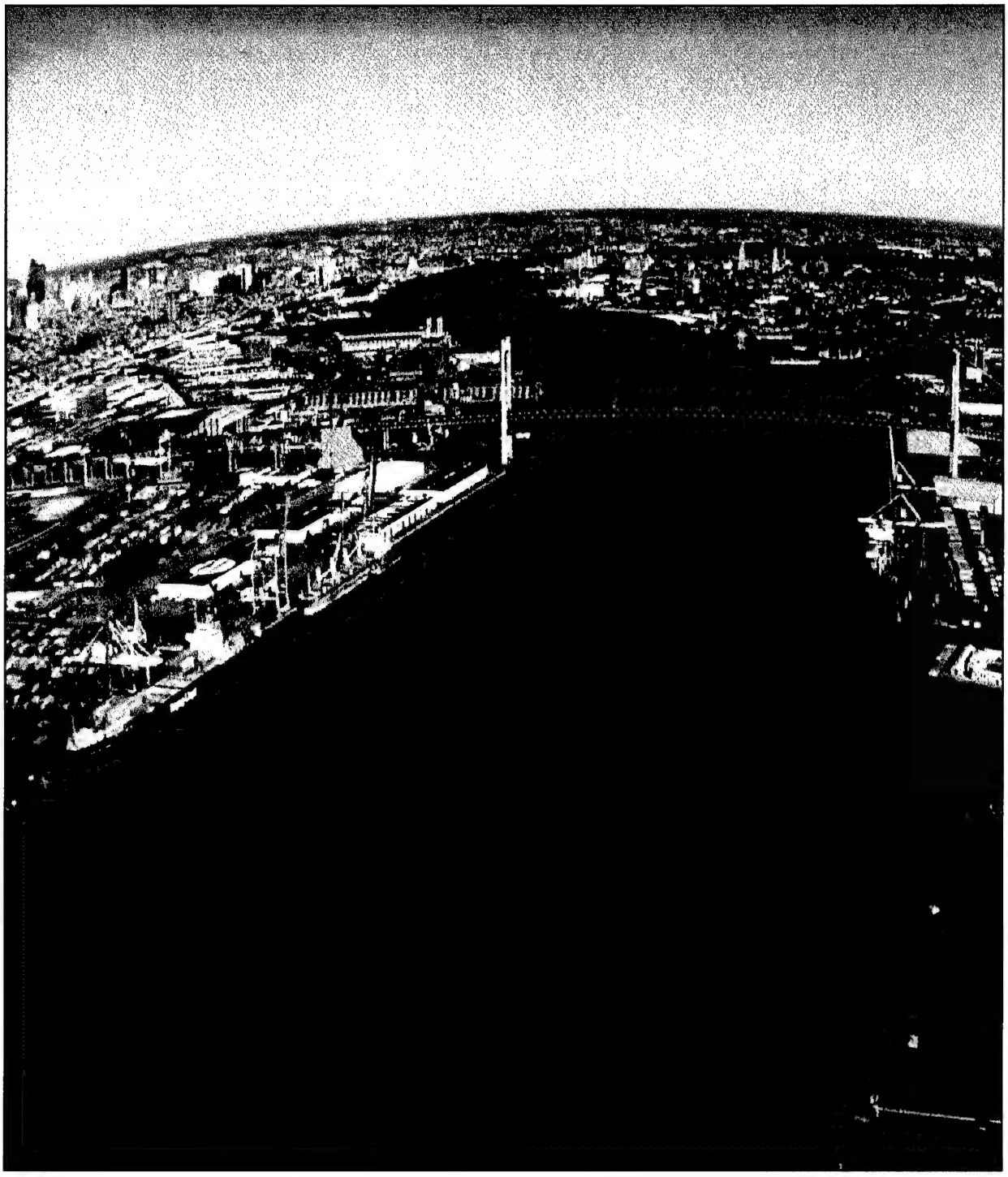
We recommend revising the Planning Orders as follows:

1. Add berthing for another FSS-sized vessel at the Howland Hook Terminal.

2. Reduce the open staging area at the Port Elizabeth Terminal to only 16 acres.

The MTMC port operator should acquire at least four portable rail end ramps.

PORT OF PHILADELPHIA, PA



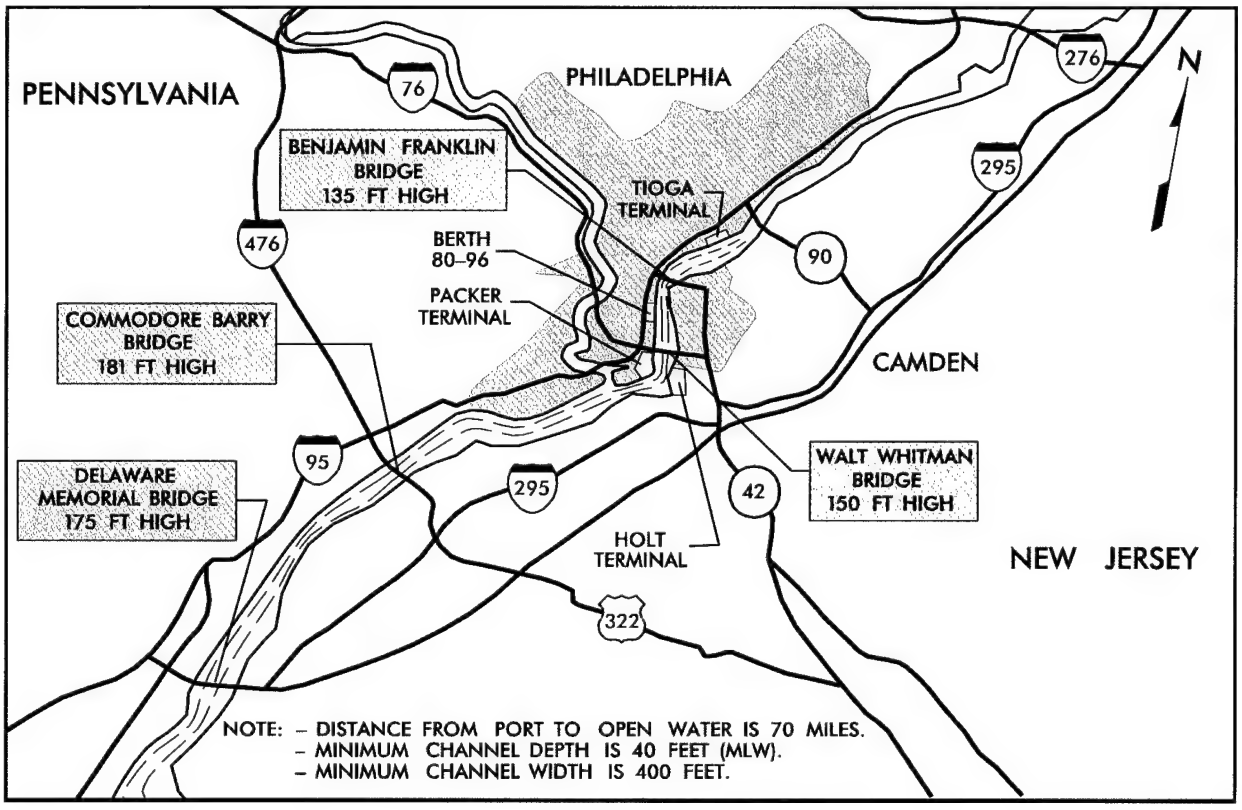
I. GENERAL DATA

TRANSPORTATION ACCESS

Water

The Port of Philadelphia is along the Delaware River about 80 nautical miles above the Delaware Capes. From the 10-mile wide entrance to the Delaware Bay, a 40-foot-deep channel leads upstream to the terminals. Four bridges spanning the Delaware River impose height restrictions ranging from 135 to 181 feet above the river at mean high water (MHW). Anchorage is available in the river and the bay. The mean tidal range is 5.7 feet at the port. The velocity of spring tidal currents at the terminals is 2-1/2 knots.

This report looks at four terminal complexes within the Port of Philadelphia. Three of the complexes are along the west bank of the Delaware River: Piers 80-96; Tioga Container Terminal; and Packer Avenue Marine Terminal. The fourth complex, Holt Marine Terminal, is on the east bank of the river and beneath the Walt Whitman Bridge.



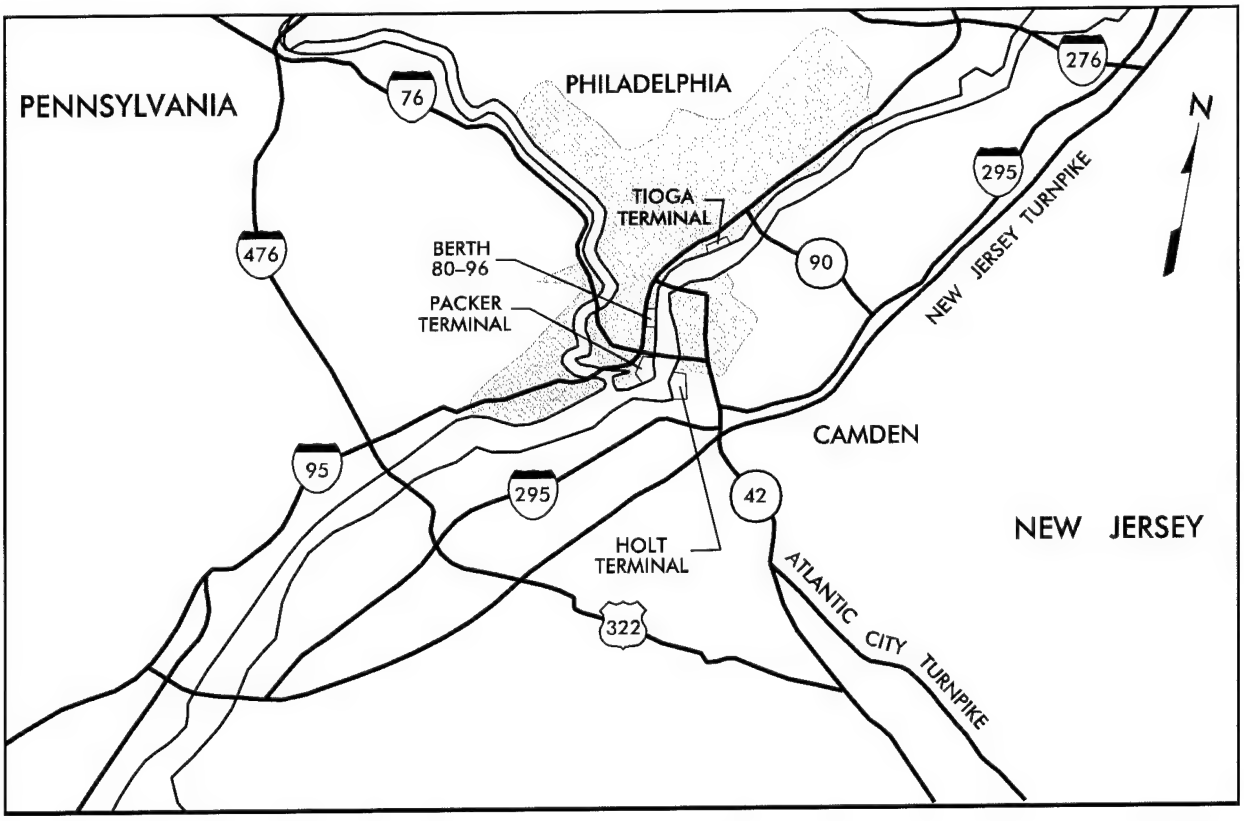
Water Access

Highway

Interstate Route 95 from the north and south and Interstate Route 76 from the east and west serve the port. Delaware Avenue, a four-lane urban street, connects all the terminals on the west side of the river.

Entry to the Packer Avenue Marine Terminal is 1 mile south of the Walt Whitman Bridge. Piers 80-96 are 2 miles north of this bridge, on Delaware Avenue. The Tioga Container Terminal is located 20 miles past the Benjamin Franklin Bridge.

From the city of Philadelphia, access to the Holt Marine Terminal, in Gloucester City, New Jersey, is via I-76 across the Walt Whitman Bridge to the Morgan Boulevard exit ramp. This exit leads into the terminal.



Highway Access

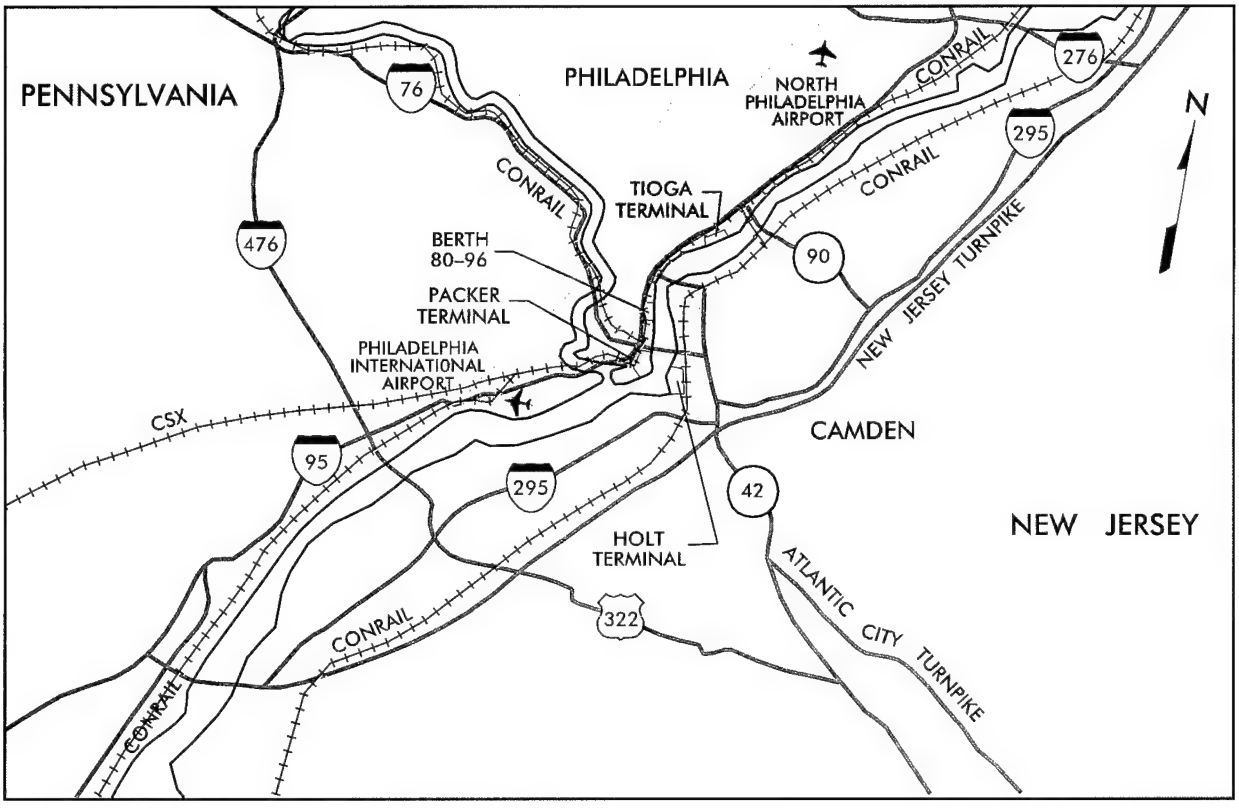
Rail

Three trunkline railroads serve the city of Philadelphia and surrounding areas: Conrail, CP Rail System (CP Rail), and CSX Transportation, Inc. (CSX). The city has one belt line, the Philadelphia Belt Line Railroad, that performs switching and operates transfer facilities for the railroad lines within the city.

Philadelphia has four major classification yards: 44th Street, Frankford Junction, Pavonia, and Greenwich. The Greenwich yard can store 1,800 cars. The other three have a combined capacity of 5,000 cars.

Airports

Philadelphia has two commercial airports that could receive incoming military aircraft. One is the Philadelphia International Airport, located southwest of the Packer Avenue Terminal and near all the terminals. The other is Northeast Philadelphia Airport, which is the closer airport to the Tioga Terminal.



Rail and Air Access

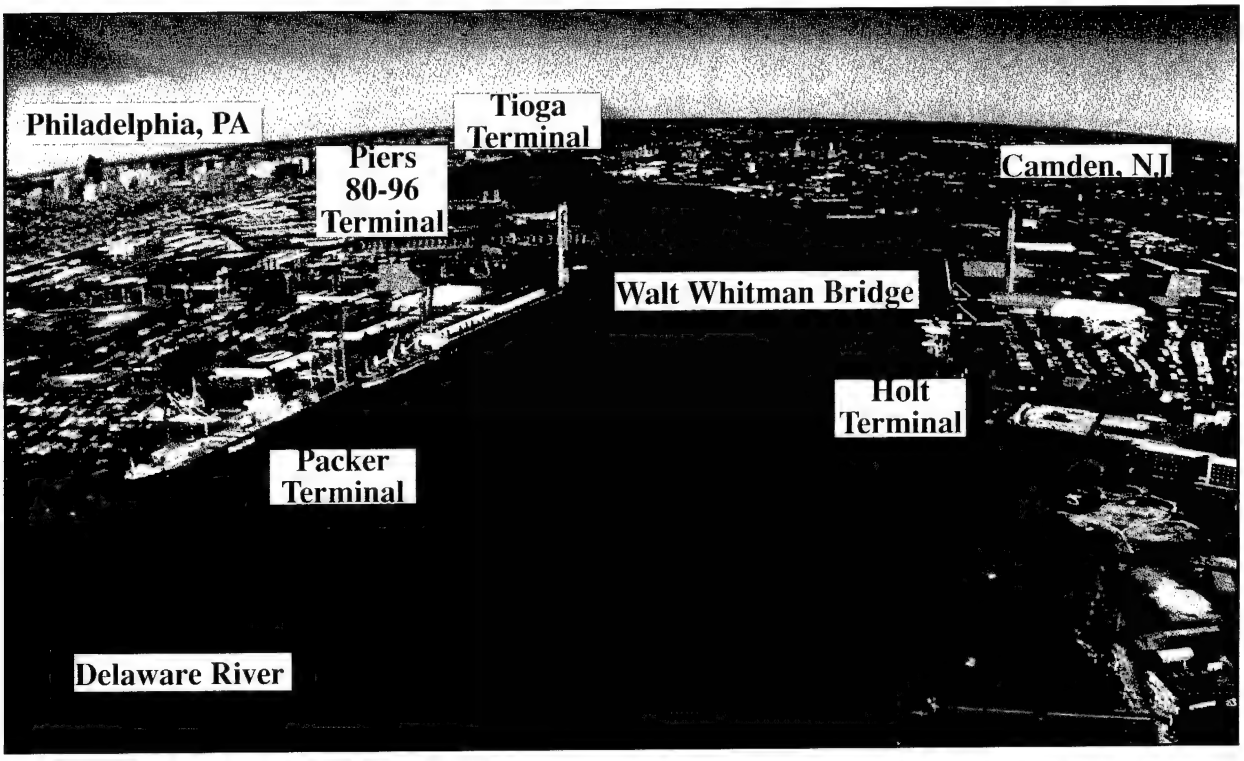
PORT FACILITIES

Berthing

This report covers four terminals. The terminals are: Piers 80-96; Tioga Container Terminal; Packer Avenue Marine Terminal; and Holt Marine Terminal. These terminals are a mixture of breakbulk and container facilities consisting of marginal wharves and finger piers. Some facilities have transit sheds on the piers to support conventional breakbulk cargo.

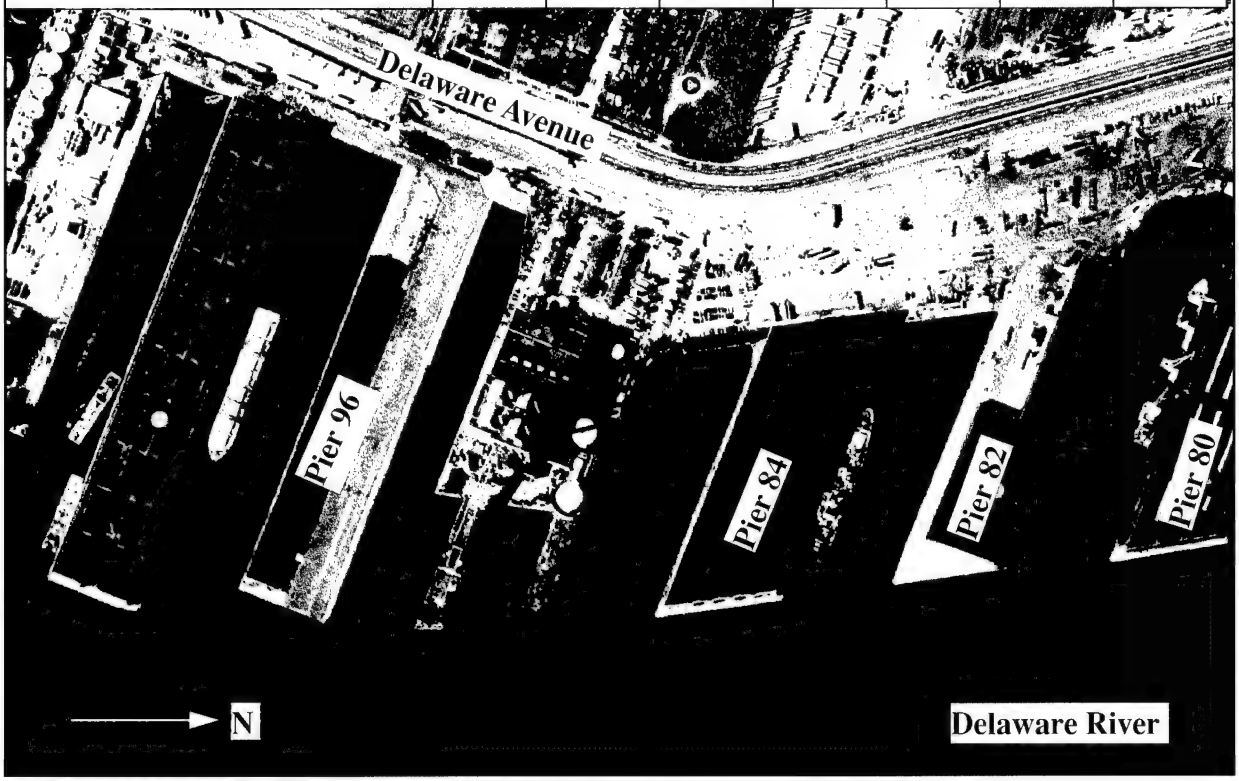
Pier construction varies from terminal to terminal. Many of the terminals have apron tracks as well as wharf and/or container cranes. Water depth ranges from 30 to 40 feet MLW.

This section contains land-use maps and aerial views of the terminals. Also included are tables identifying the berth characteristics at each terminal.

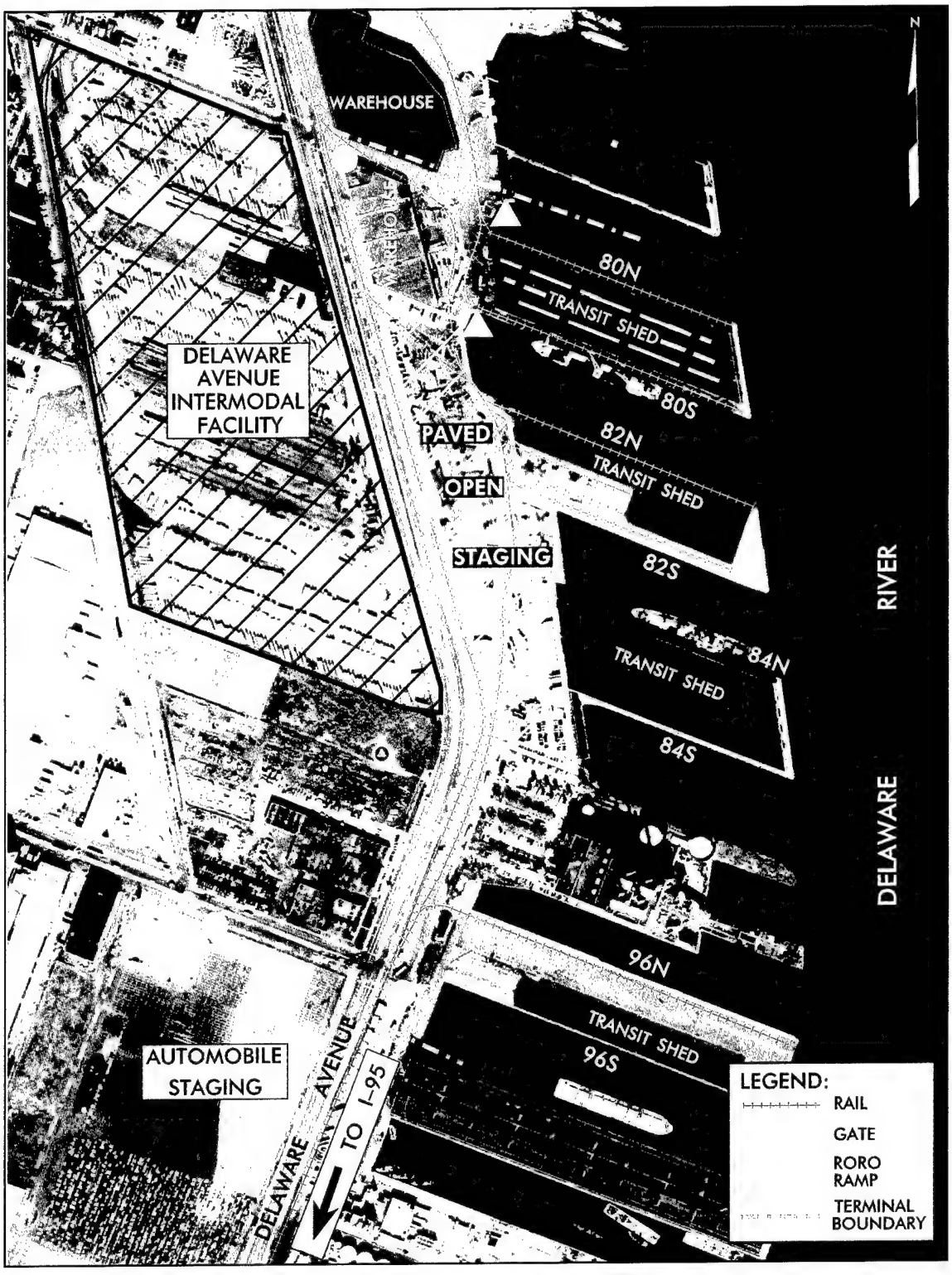


Terminal Locations (Northward view)

BERTHING CHARACTERISTICS OF PIERS 80-96							
Characteristics	**Berths**						
	80N	**80S**	**82N**	**82S**	**84N**	**84S**	**96N**
Length (ft)	994	1,144	1,139	855	855	855	1,320
Depth alongside at MLW (ft)	35	35	30	30	30	30	30
Deck strength (psf)	1,000	1,000	800	800	800	800	500
Apron width (ft)	38	38	30	110	23	23	110
Apron height above MLW (ft)	11	11	12	8	10	10	14
Number of container cranes	0	0	0	0	0	0	0
Number of wharf cranes	0	0	0	0	0	0	0
Apron lighting	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Straight-stern RORO facilities	Yes	Yes	No	No	No	No	No
Apron length served by rail (ft)	990	1,140	1,135	850	0	0	1,320



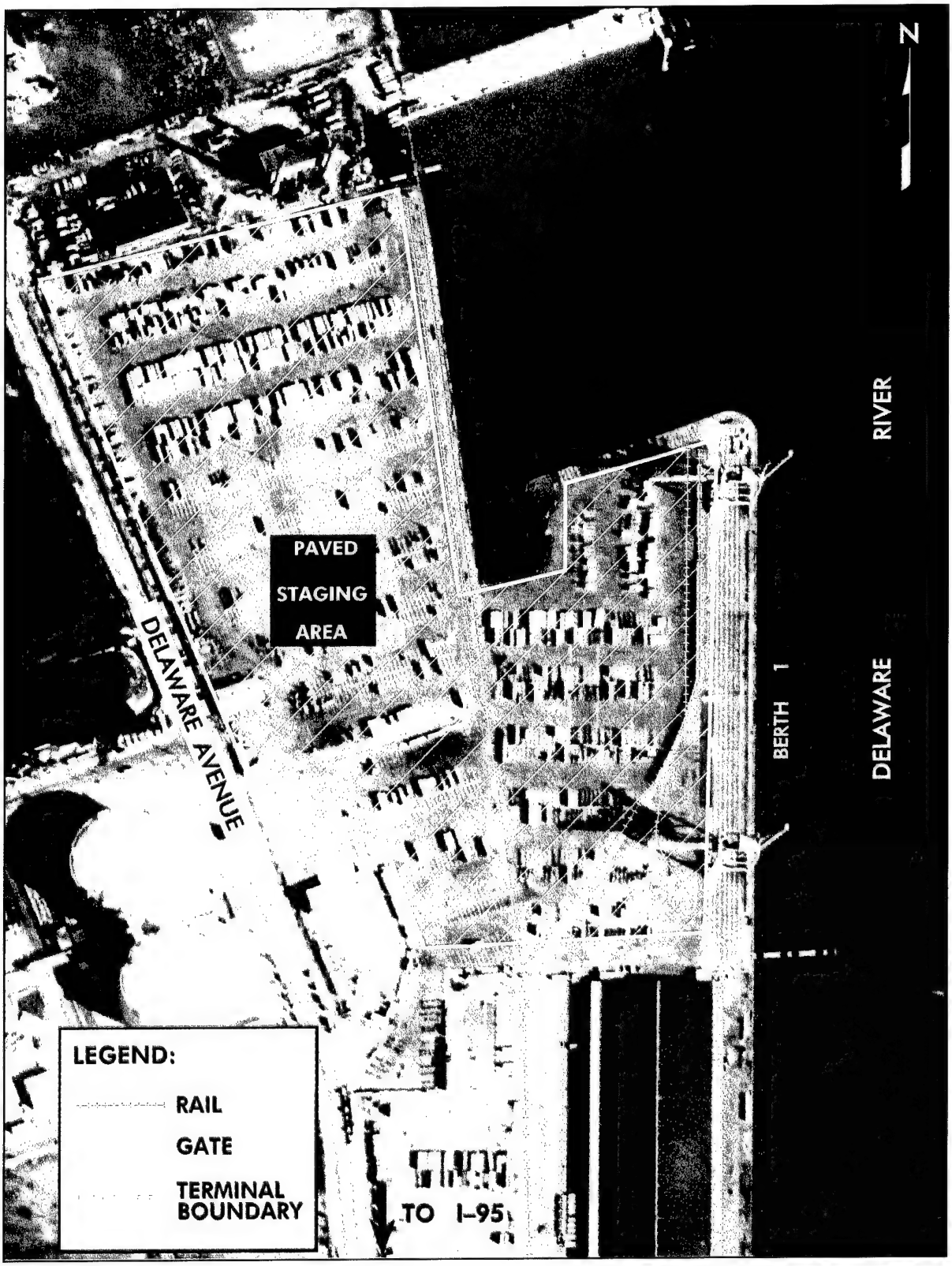
Piers 80-96



Piers 80-96 Terminal Land-Use Map

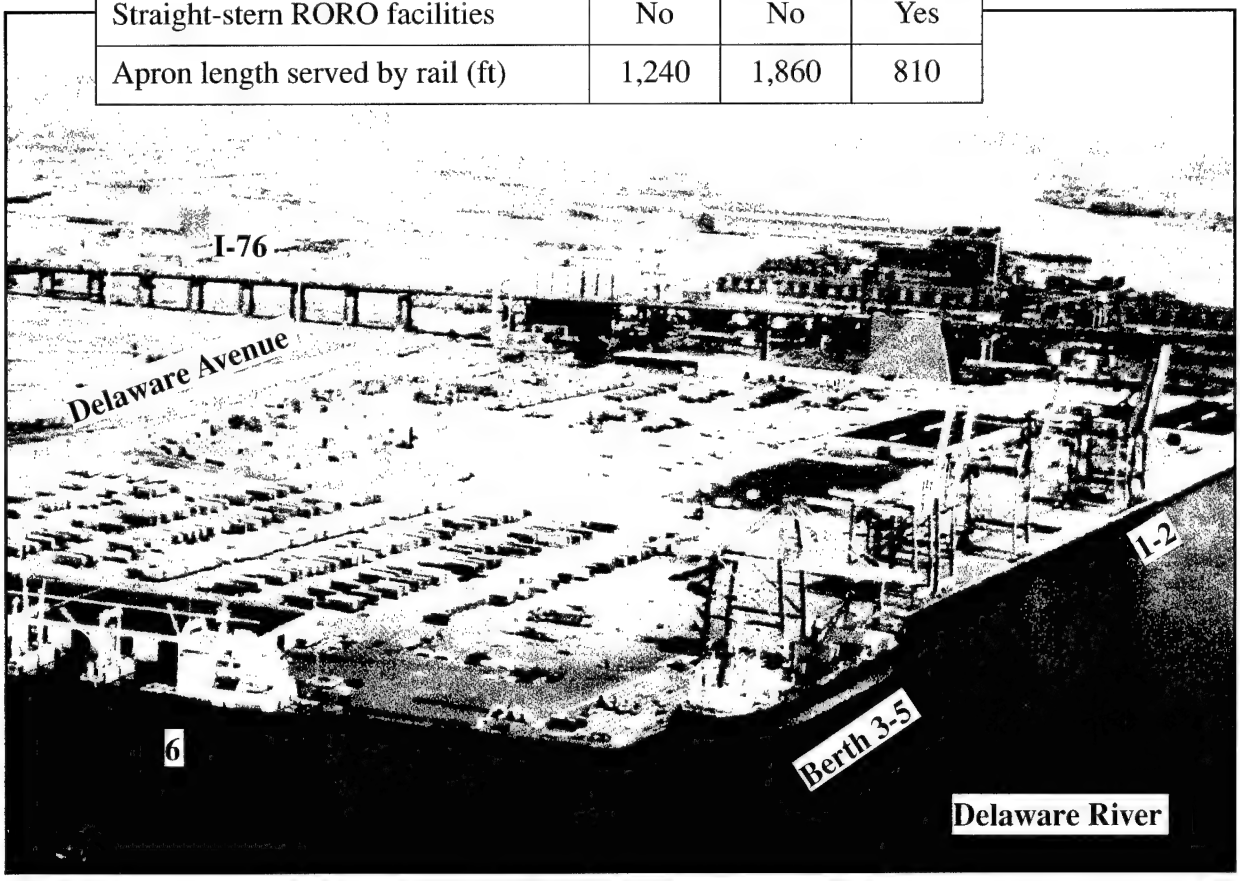
BERTHING CHARACTERISTICS OF TIOGA CONTAINER TERMINAL	
Characteristics	**Berth 1**
Length (ft)	1,425
Depth alongside at MLW (ft)	40
Deck strength (psf)	1,000
Apron width (ft)	Open
Apron height above MLW (ft)	12
Number of container cranes	2
Number of wharf cranes	0
Apron lighting	Yes
Straight-stern RORO facilities	No
Apron length served by rail (ft)	0

Tioga Container Terminal (Eastward view)

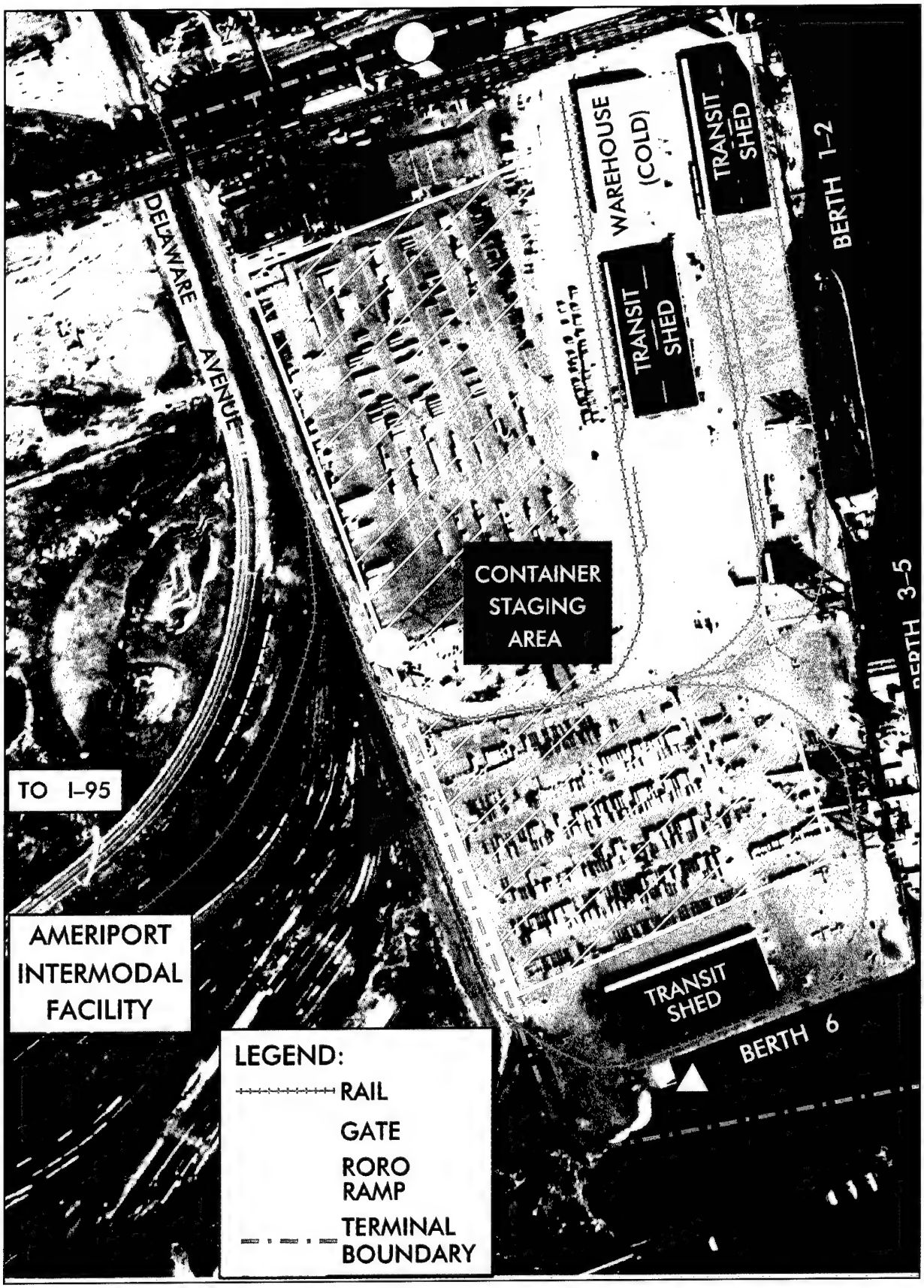


Tioga Container Terminal Land-Use Map

BERTHING CHARACTERISTICS OF PACKER AVENUE MARINE TERMINAL			
Characteristics	**Berths**		
	1-2	**3-5**	**6**
Length (ft)	1,240	1,860	816
Depth alongside at MLW (ft)	40	40	40
Deck strength (psf)	1,000	1,000	1,000
Apron width (ft)	40	Open	40
Apron height above MLW (ft)	13	13	13
Number of container cranes	0	5	1
Number of wharf cranes	0	0	0
Apron lighting	Yes	Yes	Yes
Straight-stern RORO facilities	No	No	Yes
Apron length served by rail (ft)	1,240	1,860	810

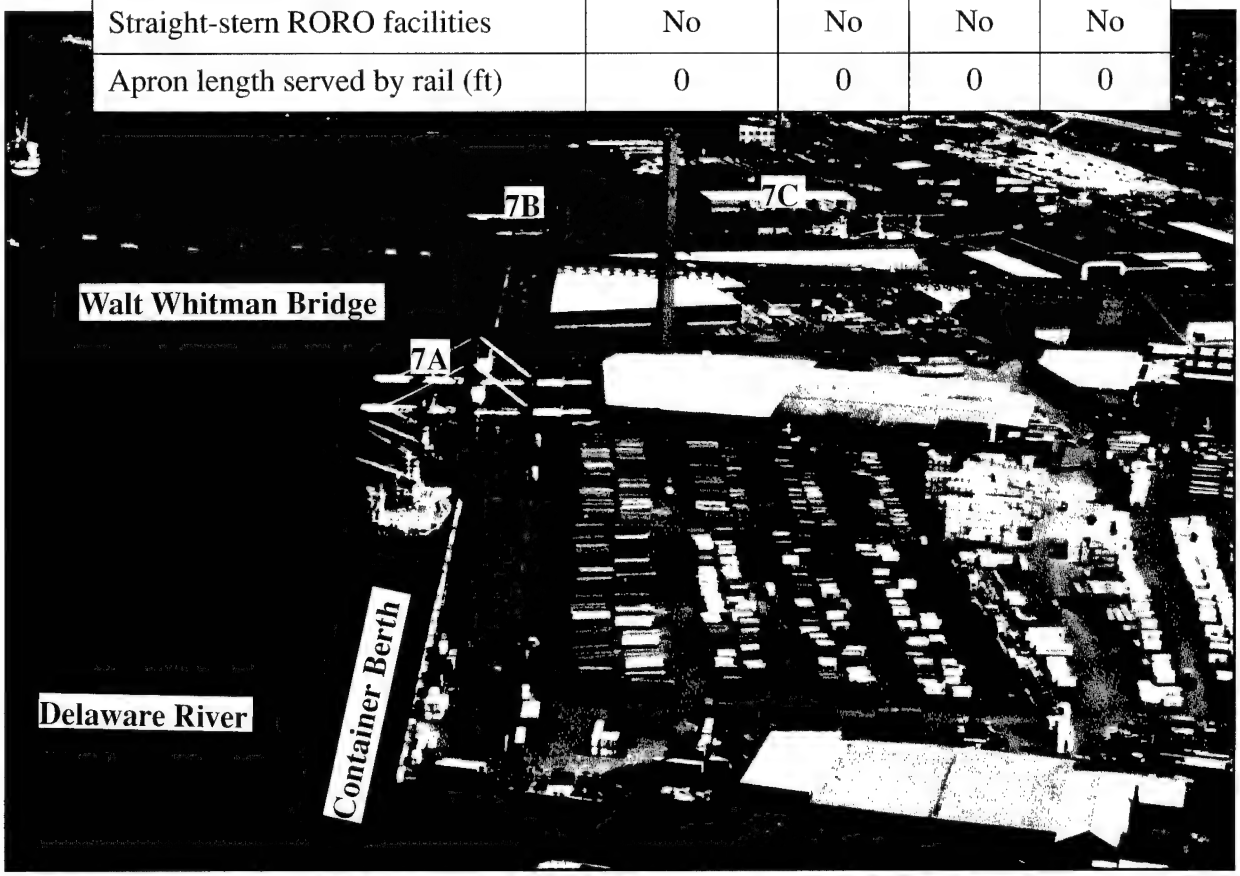


Packer Avenue Marine Terminal (Northward view)

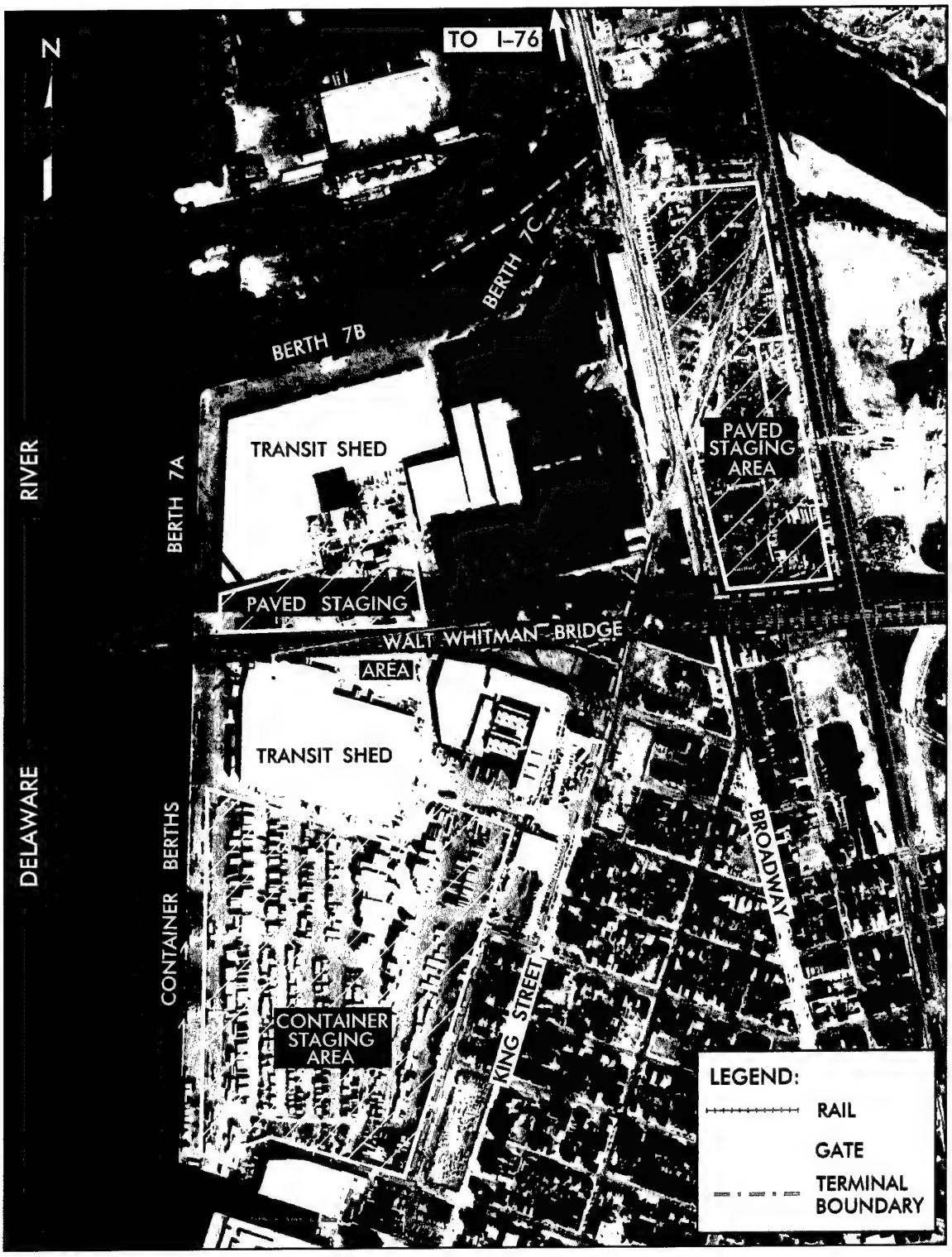


Packer Avenue Marine Terminal Land-Use Map

BERTHING CHARACTERISTICS OF HOLT MARINE TERMINAL				
Characteristics	**Berths**			
	Container	**7A**	**7B**	**7C**
Length (ft)	2,100	900	1,325	400
Depth alongside at MLW (ft)	40	40	40	40
Deck strength (psf)	1,000	1,000	1,000	1,000
Apron width (ft)	Open	75	75	Open
Apron height above MLW (ft)	12	12	12	12
Number of container cranes	2	0	0	0
Number of wharf cranes	0	0	0	0
Apron lighting	Yes	Yes	Yes	Yes
Straight-stern RORO facilities	No	No	No	No
Apron length served by rail (ft)	0	0	0	0



Holt Marine Terminal (Northward view)



Holt Marine Terminal Land-Use Map

Staging

Open Staging. The terminals in this report have a total of 279 acres of paved open staging. Helicopter operations are possible in open staging areas at Tioga Container Terminal and Holt Marine Terminal. Staging areas at each terminal are identified below.

Covered Staging. The terminals have a total of 12 covered storage facilities (transit sheds and warehouses) that provide about 2,190,000 square feet of storage. The table below identifies the location of staging areas by terminal.

STAGING AREAS

TERMINAL	COVERED (SQ FT)	OPEN PAVED (ACRES)	OPEN GRAVEL (ACRES)
Piers 80-96	800,000	29	0
Tioga Container Terminal	300,000	83	0
Packer Avenue Marine Terminal	290,000	63	0
Holt Marine Terminal	800,000	104	0

Rail

Rail trackage links the railyards to the terminal's apron tracks, transit sheds, and storage tracks. All the rail serving the terminals is in good condition with no operating restrictions. There are numerous locations that could support offloading with temporary or portable ramps. The table below provides characteristics of the rail facilities at each terminal.

RAIL CHARACTERISTICS

TERMINAL	TERMINAL TRACK (FT)*	STORAGE CAPACITY (89-FT RAILCARS) **	RAMPS (#)	DOCK POSITIONS
Piers 80-96	3,000	15	0	40
Tioga Container Terminal	7,000	56	0	0
Packer Avenue Marine Terminal	7,000	22	0	36
Holt Marine Terminal	2,500	15	0	0

*Excluding apron track.

**Storage capacity based on rail spurs and sidings.

Marshaling Areas

Mustin Airfield, a Naval Yard, is about 4 miles southwest of the central harbor area. Roadable vehicles and equipment could be marshaled here. Veterans Stadium is located just north of Mustin Airfield and has about 5.5 acres of paved parking available. This area could be used to stage equipment, if necessary.

MATERIAL HANDLING EQUIPMENT (MHE)

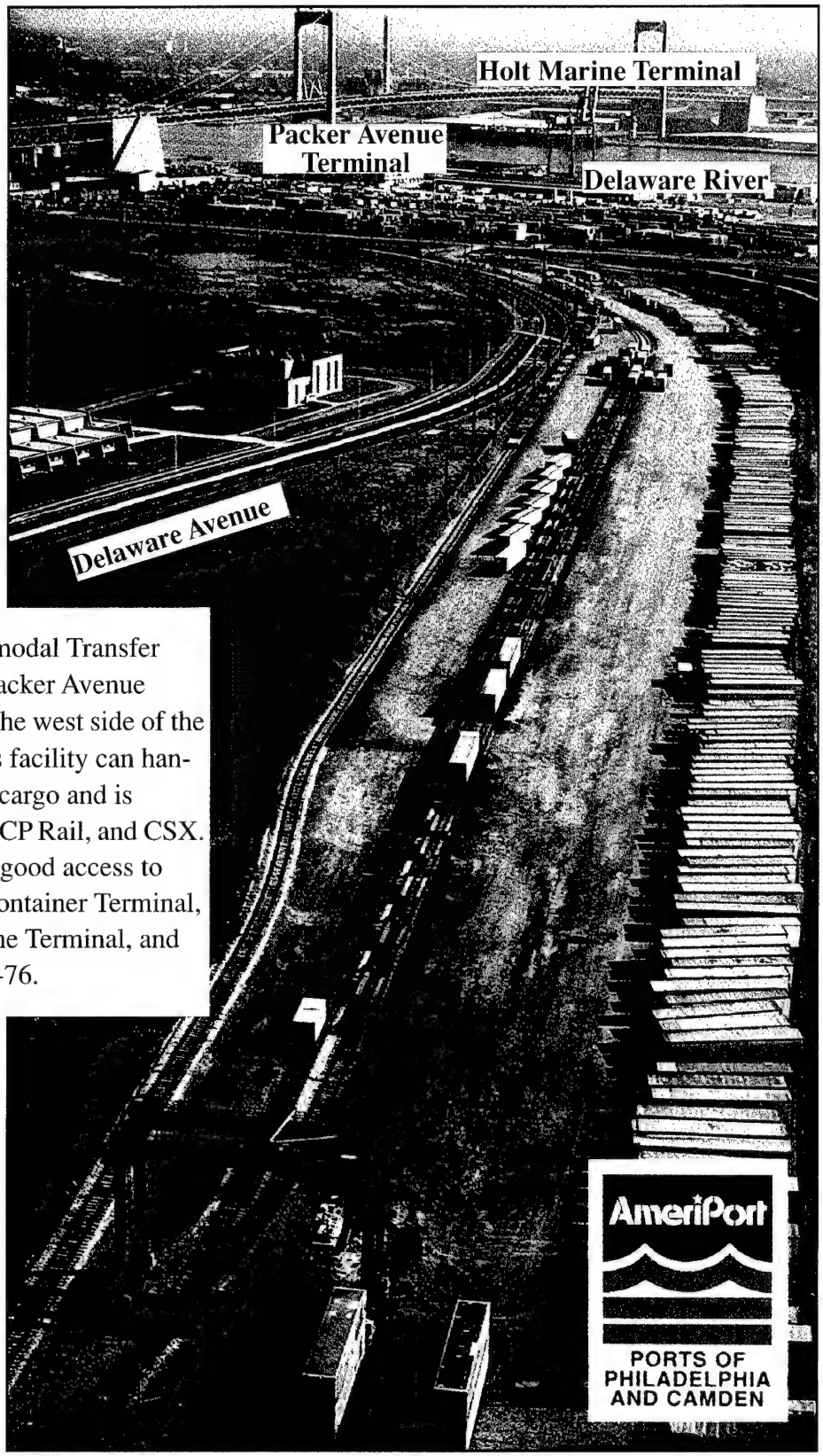
The terminals have a total of 10 container cranes that are at Packer Avenue Marine Terminal, Tioga Container Terminal, and Holt Marine Terminal. All have a capacity of at least 35 STON. Various shipping and rental companies in the area own transtainers and other MHE. Mobile cranes with capacities up to 150 STON and other MHE are available from local stevedore companies. The table below provides the equipment available by terminal.

TYPE OF EQUIPMENT	CAPACITY (STON)	QUANTITY BY TERMINAL			
		PIERS 80-96	TIOGA	PACKER	HOLT
Container Cranes	30-200	0	2	6	2
Mobile Cranes	10-150	1	0	3	4
Top Picks	30-45	0	4	11	0
Forklifts	1.5-25	25	1	100	5
Yard Hustlers	-	20	25	20	20

INTERMODAL FACILITIES

Holt Marine Terminal is an intermodal container transfer facility. It has good highway connections to I-95 and I-76. Conrail provides service to the terminal.

The Delaware Avenue Intermodal Facility is located across Delaware Avenue from Piers 82 and 84. It is owned and operated by CSX and Sealand. The terminal area is 46 acres. Eleven track spurs provide storage for about 100 89-foot railcars.



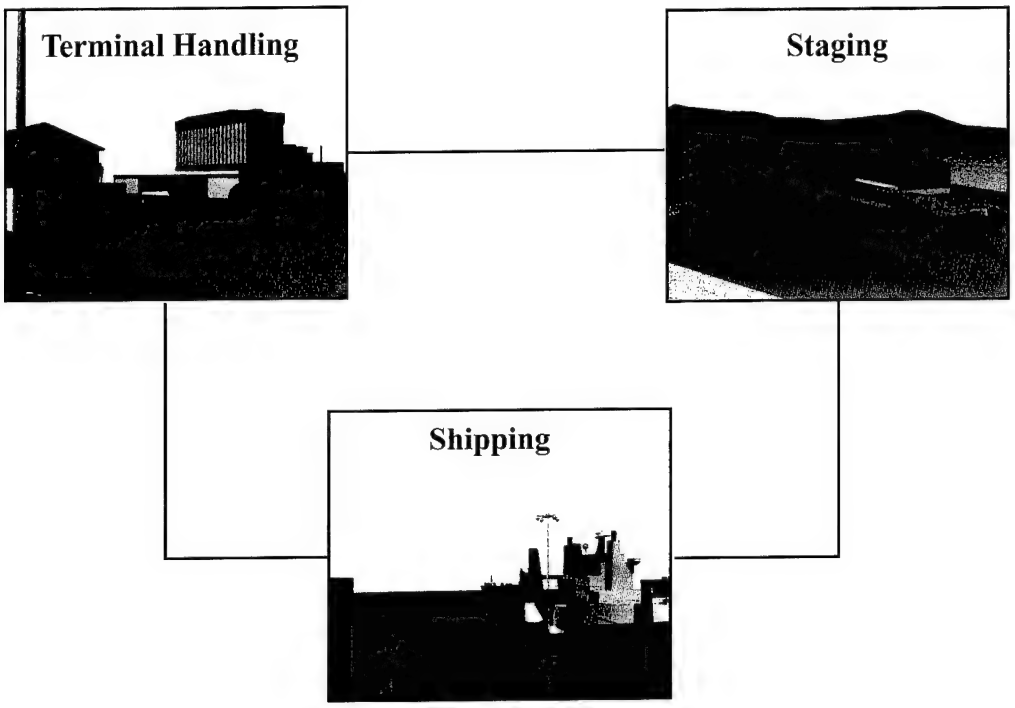
The Ameriport Intermodal Transfer Yard is adjacent to Packer Avenue Marine Terminal on the west side of the Delaware River. This facility can handle all containerized cargo and is accessed by Conrail, CP Rail, and CSX. Its location provides good access to Piers 80-96, Tioga Container Terminal, Packer Avenue Marine Terminal, and Highways I-95 and I-76.

Ameriport Intermodal Transfer Yard (Eastward view)

II. THROUGHPUT ANALYSIS

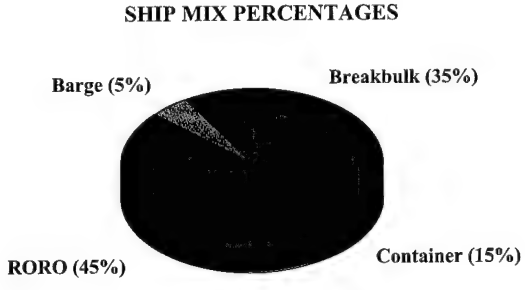
GENERAL

This section evaluates the throughput capability of the Port of Philadelphia using the port operational performance simulator (POPS) computer model. The model is based on a weak-link analysis in which each subsystem is analyzed separately and then compared to find the least capable subsystem. The weakest subsystem defines the maximum throughput capability of the terminal. The model yields throughput capability values for three subsystems - shipping, staging, and terminal processing/handling - in measurement tons (MTON) per day.



Terminal Throughput Subsystems

This analysis assumes a maximum of 80 percent of the port facilities can be made available at any one time. For this reason, we ran all port analyses using an 80 percent facility use factor. Also, the ship mix is based on Desert Shield and Desert Storm statistics. We weighted the percentages to adjust for differences in cargo deadweights and expectations for future deployments.



RECEPTION/HANDLING

Highway

I-95 and I-76 provide access to the terminals. Each terminal has a designated entrance for trucks. The road network in and out of the terminals, including the gate processing of vehicles, could handle about 270,000 MTON of equipment and supplies per day.

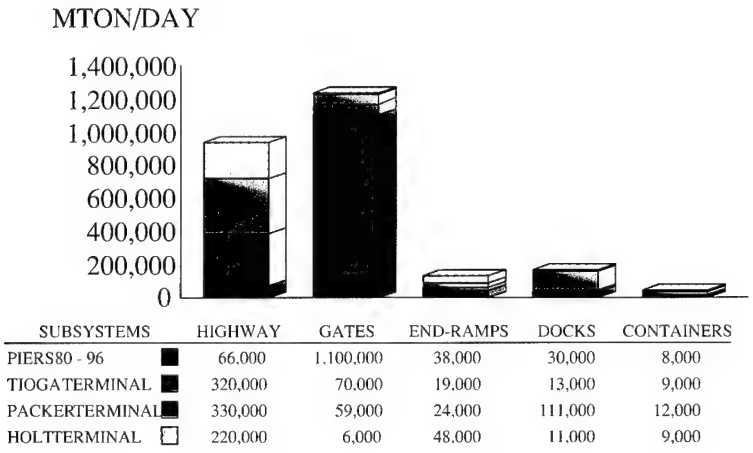
Roadable vehicles in convoys will process directly to the staging areas. Vehicles on commercial or military flatbed trailers without integral ramps will offload at portable end ramps.

Supplies in van semitrailers will proceed to van-handling positions. These docks can offload more than 55,000 MTON of van semitrailer-shipped material per day. Container handlers can offload about 158,000 MTON of chassis cargo per day.

Truck Handling Facilities

Terminal	Truck End Ramps	Van Handling Positions	Container Handlers
Piers 80-96	8	60	2
Tioga	10	33	10
Packer Avenue	5	66	10
Holt Marine	10	33	10

HIGHWAY RECEPTION/HANDLING CAPABILITY

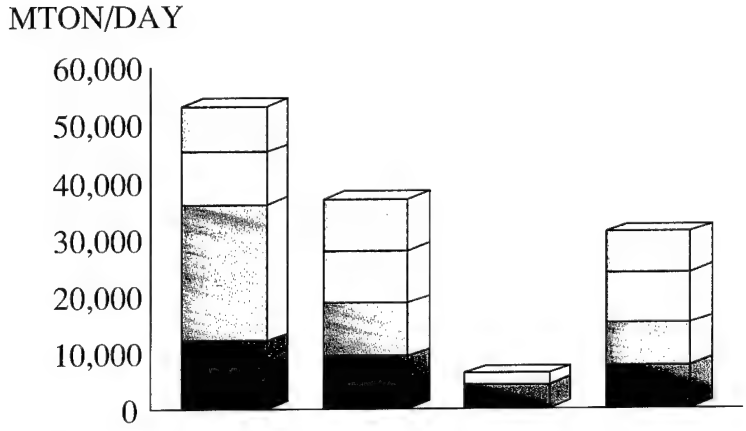


Rail

Rail reception at the port is good with three railroad companies accessing the Port of Philadelphia area. All terminals have good rail service.

Terminal	Train Length (railcars)	Trains Per Day	Rail End Ramps	Boxcar Docks	Container Handlers
Piers 80-96	60	2	1 (portable)	40	2
Tioga	100	2	1 (portable)	0	2
Packer Avenue	50	3	1 (portable)	36	2
Holt Marine	35	3	1 (portable)	0	2

RAIL RECEPTION/HANDLING CAPABILITY



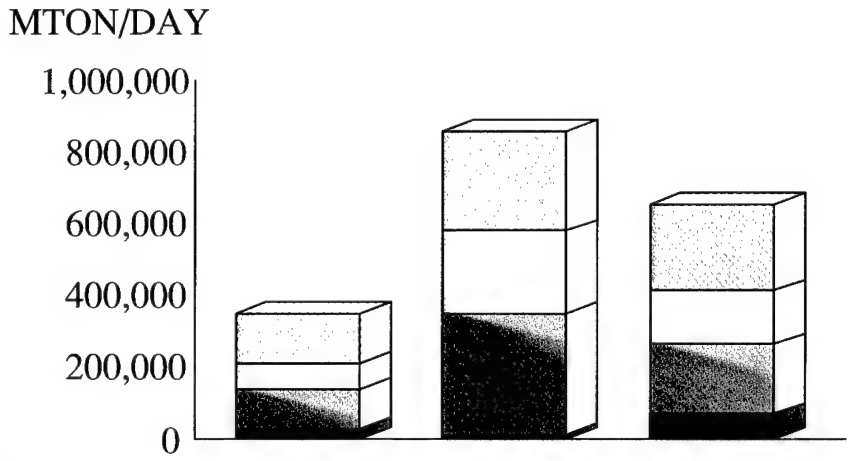
SUBSYSTEMS	TRACKAGE	END-RAMPS	DOCKS	COFC
PIERS 80 - 96	12,000	9,300	4,300	7,600
TIOGA TERMINAL	24,000	9,300	0	7,400
PACKER TERMINAL	9,300	9,300	2,000	9,000
HOLT TERMINAL	8,000	9,000	0	7,000

Staging

The terminals of this report have a total of about 279 acres of paved open staging. The terminals also have more than 2.7 million square feet of covered storage.

Terminal	Covered (Sq Ft)	Open Paved (Acres)	Open Gravel (Acres)
Piers 80-96	800,000	29	0
Tioga	300,000	83	0
Packer Avenue	290,000	63	0
Holt Marine	800,000	104	0

OPEN STAGING CAPABILITY

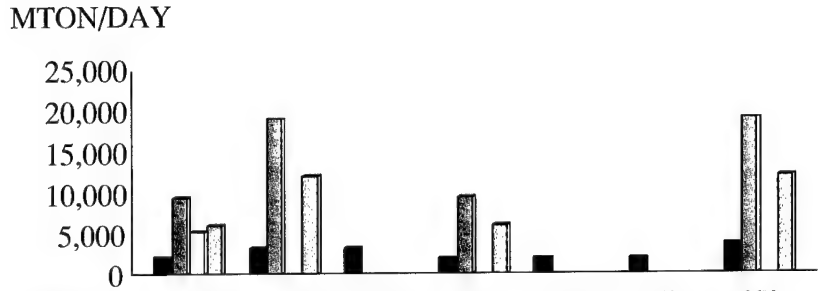


VESSEL TYPE	RORO	CONTAINERS	BREAKBULK
PIERS 80 - 96	28,000	8,000	68,000
TIOGA TERMINAL	110,000	340,000	194,000
PACKER TERMINAL	72,000	230,000	150,000
HOLT TERMINAL	140,000	280,000	240,000

Shipping

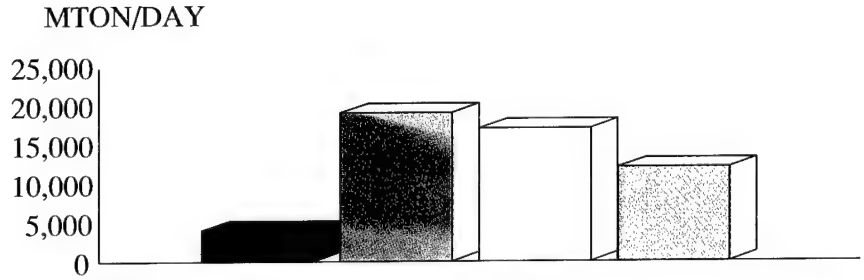
Throughputs for each berth are shown below. They are based on various factors including MHE used, loading, operational, and berth usage rates as well as berth/ship compatibility.

PIERS 80 - 96
BERTH THROUGHPUT CAPABILITY



BERTH	80N	80S	82N	82S	84N	84S	96N
BREAKBULK	2,100	3,200	3,200	1,900	1,900	1,900	3,700
RORO	9,400	19,000	0	9,400	0	0	19,000
CONTAINER	5,300	0	0	0	0	0	0
MIXED	6,100	12,000	0	6,100	0	0	12,000

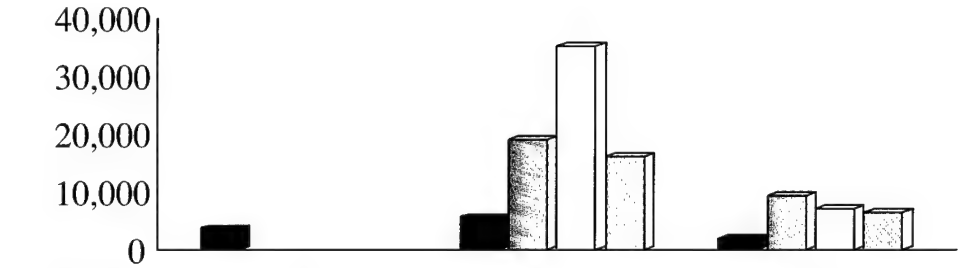
TIOGA CONTAINER TERMINAL
BERTH THROUGHPUT CAPABILITY



BERTH	BERTH 1
BREAKBULK	4,000
RORO	19,000
CONTAINER	17,000
MIXED	12,000

PACKER AVENUE MARINE TERMINAL
BERTH THROUGHPUT CAPABILITY

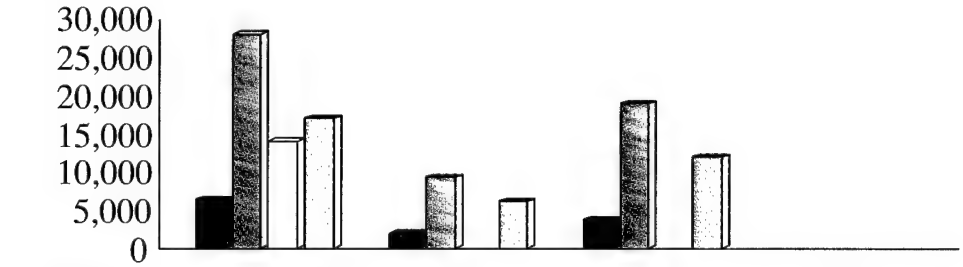
MTON/DAY



BERTH	1-2	3-5	6
BREAKBULK	3,700	5,600	1,900
RORO	0	19,000	9,400
CONTAINER	0	35,000	7,000
MIXED	0	16,000	6,300

HOLT MARINE TERMINAL
BERTH THROUGHPUT CAPABILITY

MTON/DAY



BERTH	CONTAINER	7A	7B	7C
BREAKBULK	6,500	2,000	3,800	0
RORO	28,000	9,400	19,000	0
CONTAINER	14,000	0	0	0
MIXED	17,000	6,200	12,000	0

CONVERSION FACTORS	
Breakbulk	.4 STON per MTON
RORO	.25 STON per MTON
Containers	.4 STON per MTON

The type of ship preferred at each berth is based on the methodology described in Appendix B. The evaluation is based on a snapshot view of the current physical characteristics of the berths and the MHE available. The evaluation below gives no considerations for enhancements, such as equipment. The lower the number for a berth, the better the berth is suitable for loading and unloading operations.

Packer Avenue Marine Terminal best supports FSS and LMSR operations. An FSS would likely berth at Berth 3-5, with port side to the wharf. LMSR vessels can also load at this berth without loading restrictions.

PREFERENCE BERTH SELECTION

BERTH	BB	RORO	CNTNR
PIERS 80-96			
80	2	7	5
82	4	-	9
84	6	-	11
96	4	-	10
TIOGA			
Berth 1	8	6	4
PACKER			
1-2	1	-	1
3-5	6	1	1
6	2	2	6
HOLT			
Container	9	3	3
7A	10	3	8
7B	10	3	7
7C	-	-	-

SUMMARY OF BERTHING CAPABILITIES OF PIERS 80 AND 82

Vessel	Berths			
	Pier 80N	Pier 80S	Pier 82N	Pier 82S
Breakbulk				
C3-S-33a	1	2	a	a
C3-S-37c	1	2	a	a
C3-S-37d	1	2	2	1
C3-S-38a	1	2	2	1
C4-S-1a	1	1	1	1
C4-S-1qb and 1u	1	1	a	a
C4-S-58a	1	1	a	a
C4-S-65a	1	1	1	1
C4-S-66a	1	2	a	a
C4-S-69b	1	1	a	a
Seatrain				
GA and PR-class	1	1	1	1
Barge				
LASH C8-S-81b	1	1	a,f	a,f
LASH C9-S-81d	a	a	a	a,c
LASH lighter	7	8	8	6
SEABEE C8-S-82a	a	a	a	a,c
SEABEE barge	4	5	5	4
RORO				
Comet	1,i	2,i	d,o	1,d,i
C7-S-95a/Maine-class	b	b	a,b	a
Ponce-class	b,h	b,h	b,h	h
Great Land-class	b,h	b,h	b,h	b
Cygnus/Pilot-class	b	b	b	1
Meteor	i,j	i,j	d,o	1,d,i
AmEagle/Condor	b	b	b	1,i
MV Ambassador	l,m	l,m	d	d
FSS-class	b	b	a,b	a,c
Cape D-class	b	b	a,b	a
Cape H-class	a,b	a,b	a,b	a
LMSR	b	b	a,b	a,c
Container				
C6-S-lw	1,e	1,e	1,e	1,e
C7-S-68e	1,e	1,e	a,e	a,e
C8-S-85c	1,e	1,e	a,e	a,e
Combination				
C5-S-78a	1,e	1,e	a,e	a,e
C5-S-37e	1,e	1,e	1,e	1,e

a=vessel draft limited to berth depth
b=inadequate apron width
c=inadequate berth length
d=no straight stern-ramp facilities
e=no container-handling equipment
f=shallow berth, adequate anchorage depth
g=inadequate channel depth
h=no shore-based ramps available
i=insufficient ramp clearance at low tide
j=insufficient ramp clearance at high tide
k=excessive ramp angle at low tide
m=excessive ramp angle at high tide
n=parallel ramp operation only
o=too narrow apron for side-ramp

Notes: Ramp clearance and ramp angle based on maximum vessel draft
( ) indicates vessels assigned by analyst

SUMMARY OF BERTHING CAPABILITIES OF PIERS 84 AND 86

Vessel	Berths		
	Pier 84N	Pier 84S	Pier 96N
Breakbulk			
C3-S-33a	a	a	a
C3-S-37c	a	a	a
C3-S-37d	1	1	2
C3-S-38a	1	1	2
C4-S-1a	1	1	2
C4-S-1qb and 1u	a	a	a
C4-S-58a	a	a	a
C4-S-65a	1	1	2
C4-S-66a	a	a	a
C4-S-69b	a	a	a
Seatrain			
GA and PR-class	1	1	2
Barge			
LASH C8-S-81b	a,f	a,f	a,f
LASH C9-S-81d	a,c	a,c	a
LASH lighter	6	6	9
SEABEE C8-S-82a	a,c	a,c	a
SEABEE barge	4	4	6
RORO			
Comet	d,o	d,o	d,i,j
C7-S-95a/Maine-class	a,b	a,b	a
Ponce-class	b,h	b,h	h
Great Land-class	b,h	b,h	h
Cygnus/Pilot-class	b	b	2
Meteor	d,o	d,o	d,i,j
AmEagle/Condor	b	b	i,j
MV Ambassador	d	d	d
FSS-class	a,b,c	a,b,c	a
Cape D-class	a,b	a,b	a
Cape H-class	a,b	a,b	a
LMSR	a,b,c	a,b,c	a
Container			
C6-S-lw	1,e	1,e	1,e
C7-S-68e	a,e	a,e	a,e
C8-S-85c	a,e	a,e	a,e
Combination			
C5-S-78a	a,e	a,e	a,e
C5-S-37e	1,e	1,e	2,e

a=vessel draft limited to berth depth
b=inadequate apron width
c=inadequate berth length
d=no straight stern-ramp facilities
e=no container-handling equipment
f=shallow berth, adequate anchorage depth
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h=no shore-based ramps available
i=insufficient ramp clearance at low tide
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k=excessive ramp angle at low tide
m=excessive ramp angle at high tide
n=parallel ramp operation only
o=too narrow apron for side-ramp

Notes: Ramp clearance and ramp angle based on maximum vessel draft
( ) indicates vessels assigned by analyst

SUMMARY OF BERTHING CAPABILITIES OF TIOGA CONTAINER TERMINAL

Vessel	Berths
	Berth 1
Breakbulk	
C3-S-33a	2
C3-S-37c	2
C3-S-37d	2
C3-S-38a	2
C4-S-1a	2
C4-S-1qb and 1u	2
C4-S-58a	2
C4-S-65a	2
C4-S-66a	2
C4-S-69b	2
Seatrain	
GA and PR-class	2
Barge	
LASH C8-S-81b	1
LASH C9-S-81d	1
LASH lighter	10
SEABEE C8-S-82a	1
SEABEE barge	7
RORO	
Comet	d,i,j
C7-S-95a/Maine-class	1
Ponce-class	h
Great Land-class	h
Cygnus/Pilot-class	2
Meteor	d,i,j
AmEagle/Condor	i,j
MV Ambassador	d
FSS-class	1
Cape D-class	i,j
Cape H-class	1
LMSR	1
Container	
C6-S-lw	2
C7-S-68e	1
C8-S-85c	1
Combination	
C5-S-78a	2
C5-S-37e	2

a=vessel draft limited to berth depth
b=inadequate apron width
c=inadequate berth length
d=no straight stern-ramp facilities
e=no container-handling equipment
f=shallow berth, adequate anchorage depth
g=inadequate channel depth
h=no shore-based ramps available
i=insufficient ramp clearance at low tide
j=insufficient ramp clearance at high tide
k=excessive ramp angle at low tide
m=excessive ramp angle at high tide
n=parallel ramp operation only
o=too narrow apron for side-ramp

Notes: Ramp clearance and ramp angle based on maximum vessel draft
( ) indicates vessels assigned by analyst

SUMMARY OF BERTHING CAPABILITIES OF PACKER AVENUE MARINE TERMINAL

Vessel	Berths		
	1-2	3-5	6
Breakbulk			
C3-S-33a	2	3	1
C3-S-37c	2	3	1
C3-S-37d	2	3	1
C3-S-38a	2	3	1
C4-S-1a	2	3	1
C4-S-1qb and 1u	2	3	1
C4-S-58a	2	3	1
C4-S-65a	2	3	1
C4-S-66a	2	3	1
C4-S-69b	2	3	1
Seatrain			
GA and PR-class	2	3	1
Barge			
LASH C8-S-81b	1	2	c
LASH C9-S-81d	1	2	c
LASH lighter	8	13	5
SEABEE C8-S-82a	1	2	c
SEABEE barge	6	9	4
RORO			
Comet	d,o	d,i,j	i,j
C7-S-95a/Maine-class	b	2	1
Ponce-class	b,h	h	h
Great Land-class	b,h	h	h
Cygnus/Pilot-class	b	2	1
Meteor	d,o	d,i,j	i,j
AmEagle/Condor	b	i,j	i,j
MV Ambassador	d	d	1,m
FSS-class	b	1	c
Cape D-class	b	i,j	i,j
Cape H-class	b	2	1
LMSR	b	1	c
Container			
C6-S-1w	1,e	2	1
C7-S-68e	1,e	2	1
C8-S-85c	1,e	2	c
Combination			
C5-S-78a	1,e	2	1
C5-S-37e	2,e	3	1

a=vessel draft limited to berth depth
b=inadequate apron width
c=inadequate berth length
d=no straight stern-ramp facilities
e=no container-handling equipment
f=shallow berth, adequate anchorage depth
g=inadequate channel depth
h=no shore-based ramps available
i=insufficient ramp clearance at low tide

Notes: Ramp clearance and ramp angle based on maximum vessel draft
( ) indicates vessels assigned by analyst

SUMMARY OF BERTHING CAPABILITIES OF HOLT MARINE TERMINAL

Vessel	Berths			
	Container	7A	7B	7C
Breakbulk				
C3-S-33a	4	1	2	c
C3-S-37c	4	1	2	c
C3-S-37d	4	1	2	c
C3-S-38a	4	1	2	c
C4-S-1a	3	1	2	c
C4-S-1qb and 1u	3	1	2	c
C4-S-58a	3	1	2	c
C4-S-65a	3	1	2	c
C4-S-66a	3	1	2	c
C4-S-69b	3	1	2	c
Seatrain				
GA and PR-class	3	1	2	c
Barge				
LASH C8-S-81b	2	1	1	c
LASH C9-S-81d	2	1	1	c
LASH lighter	15	6	9	2
SEABEE C8-S-82a	2	1	1	c
SEABEE barge	10	4	6	2
RORO				
Comet	d,i,j	d,i,j	d,i,j	c,d
C7-S-95a/Maine-class	2	1	1	c
Ponce-class	h	b,h	b,h	c,h
Great Land-class	h	b,h	b,h	c,h
Cygnus/Pilot-class	3	1	2	c
Meteor	d,i,j	d,o	d,o	c,d
AmEagle/Condor	i,j	i,j	i,j	c
MV Ambassador	d	d	d	c,d
FSS-class	2	c	1,n	c
Cape D-class	i,j	i,j	i,j	c
Cape H-class	2	1	1	c
LMSR	2	c	1,n	c
Container				
C6-S-lw	3	1,e	1,e	c,e
C7-S-68e	2	1,e	1,e	c,e
C8-S-85c	2	1,e	1,e	c,e
Combination				
C5-S-78a	3	2,e	2,e	c,e
C5-S-37e	3	2,e	2,e	c,e

a=vessel draft limited to berth depth
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Notes: Ramp clearance and ramp angle based on maximum vessel draft
( ) indicates vessels assigned by analyst

III. APPLICATION

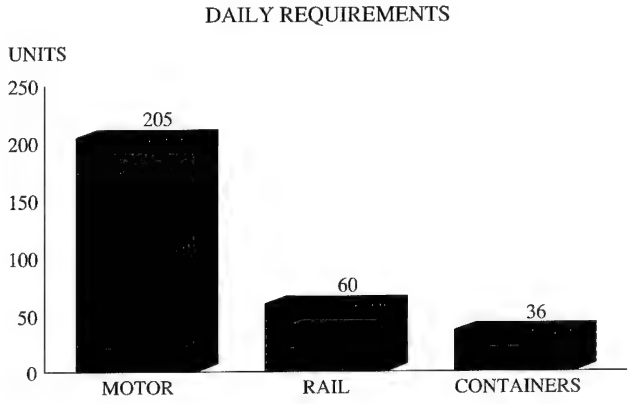
GENERAL

This section will evaluate the port's throughput capability for deploying a notional mechanized infantry brigade using primarily FSS vessels. There are currently no planning orders in effect for the Port of Philadelphia. Of the terminals in this report, only the Pier 80-96 Terminal is incapable of performing FSS operations. Light FSS vessels are unable to clear the 135 foot high Benjamin Franklin Bridge to access the Tioga Terminal. Of the remaining two terminals, the Packer Avenue Marine Terminal has the best rail facilities. For this reason, this analysis assumes the Packer Avenue terminal will be used for military operations.

REQUIREMENTS

The likely requirement for the Port of Philadelphia is to deploy a notional mechanized infantry brigade in 6 days. The brigade has to move about 2,600 vehicles and 220 containers. The movement to the port will require 360 railcars (60 per day) using the convoy/rail option. Under this option, about 1,200 (205 per day) roadable vehicles would be driven and about 775 (130 per day) would be towed.

MECHANIZED INFANTRY BRIGADE	
Total Equipment	
Volume	91,506 MTON
Weight	31,670 STON
Area	474,300 Sq Ft
Vehicles	2,600
Containers	220

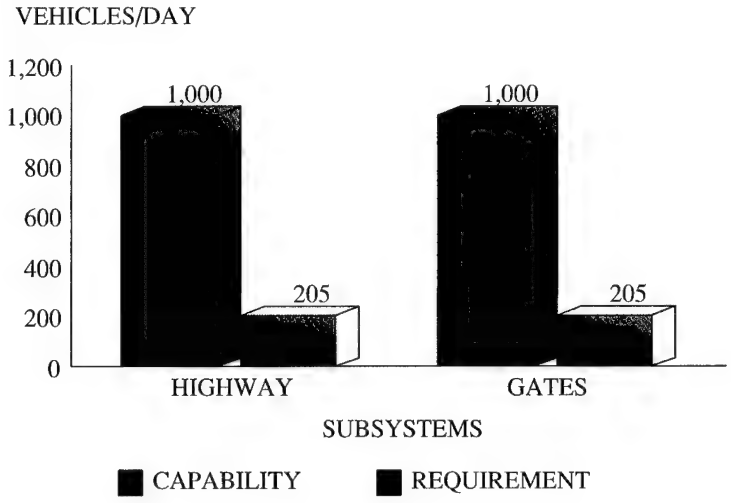


TERMINAL HANDLING

Highway

The highway routes to the port are Interstate Routes 95 and 76. Vehicles and containers on chassis would access the Packer Avenue Terminal via four-laned Delaware Avenue/Columbus Boulevard. These access roads and the gates can handle well over 1,000 vehicles per day.

HIGHWAY INPROCESSING CAPABILITY

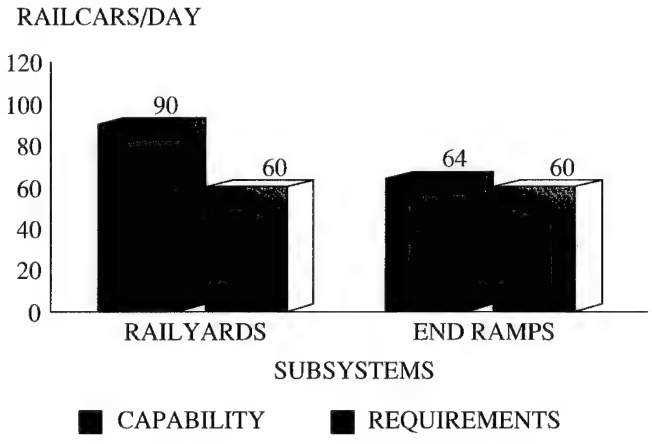


Rail

Railyards in the Philadelphia area can easily accommodate 90 railcars per day without disrupting simultaneous commercial operations. Railcars would then be switched into the port as the spurs are available to support offloading.

Two spurs that can support offloading operations are inland of the warehouses. If neither is available, the Ameriport Intermodal Transfer Yard, located across the street from the terminal, might be used for offloading operations. For this analysis, we assume that one of the 1,600-foot spurs inland of the warehouses is available. A portable or temporary ramp at the northwest corner of the refrigerated warehouse can support offloading 16 railcars. Offloading these 16 railcars every 5 hours will meet the 60 railcar per day requirement.

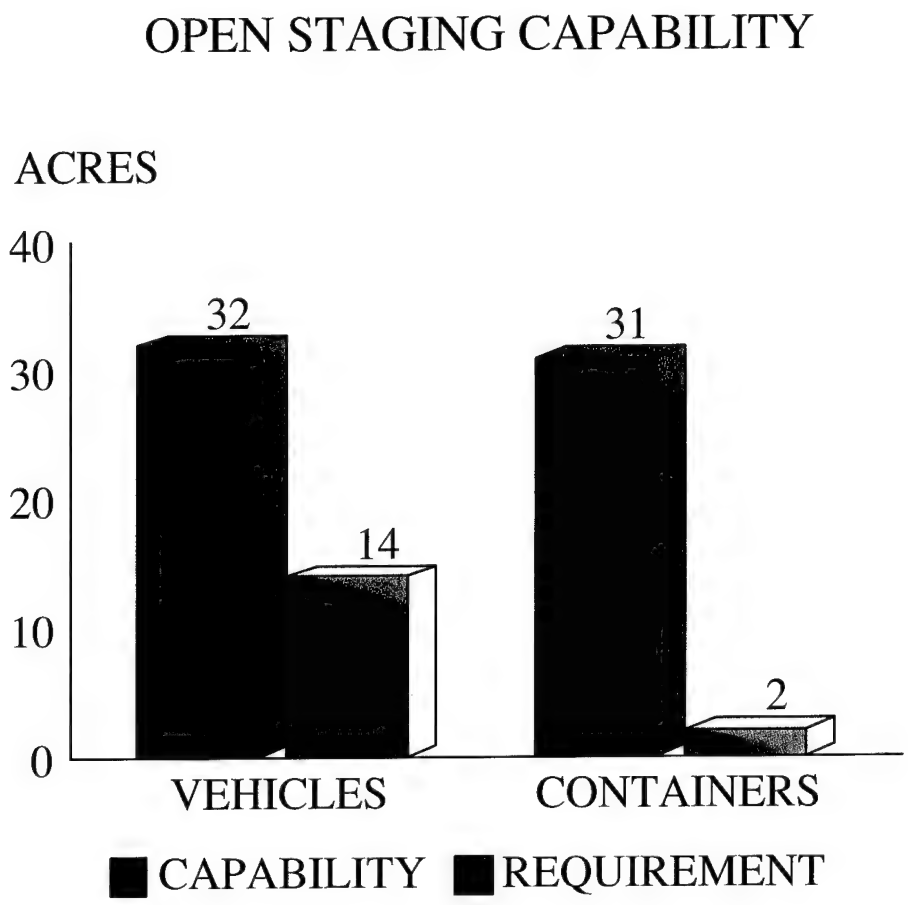
RAIL INPROCESSING AND HANDLING CAPABILITY



Staging

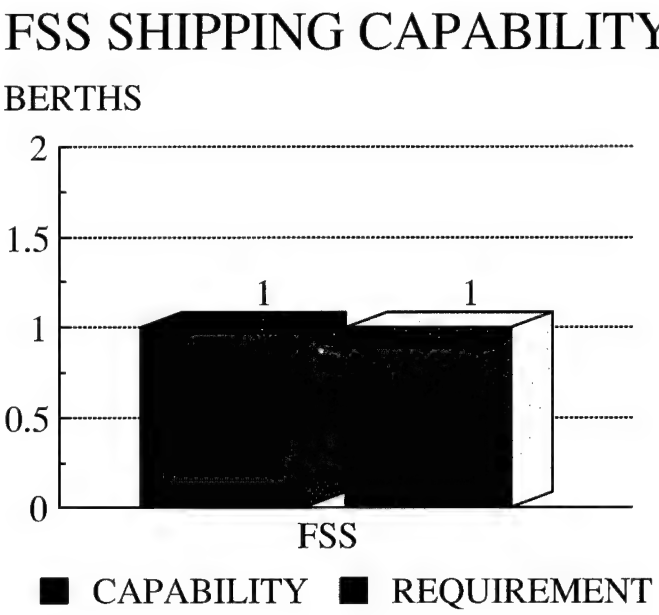
This analysis assumes that current downsizing continues, and that three FSS-sized ships will deploy an entire notional mechanized infantry brigade. One ship will depart every two days.

Although an FSS load of cargo can be staged and loaded on 10 acres, 16 acres are required for sustained loading operations. Of these 16 acres, about 2 acres are required for staging containers. The Packer Avenue Terminal has about 63 acres of paved open staging. This exceeds the requirement.



Shipping

Although this analysis assumes that three FSS-sized ships can deploy the notional mechanized infantry brigade, the table below provides ship quantities for the current brigade size. The number of ships required depends on the shipping mix selected. Berth 3-5 is 1,860 feet long and can easily support FSS and LMSR operations. This capability meets the requirement for FSS berthing.



UNIT MOVEMENT REQUIREMENTS, MECHANIZED BRIGADE

Loading Condition/ Sample Ship Mix	Vessel Types			
	FSS (RORO/Comb)	Cape H (RORO/Comb)	C3/C4 (Breakbulk)	C6/C7/C8 (Container)
Minimum Containerization:				
All FSS	3.33			
FSS and Cape H	2.22	1.00		
All Breakbulk			12.57	
Maximum Containerization:				
FSS, and Container	2.64			0.67
FSS, Cape H, and Container	1.54	1.00		0.67
Breakbulk and Container			9.86	0.67

Legend:
RORO - roll on/roll off
FSS - fast sealift ship
Source: MTMCTEA Report OA 90-4f-22, Deployment Planning Guide. Aug 91.

SUMMARY

The Port of Philadelphia has adequate characteristics to support the deployment of a brigade. Berth 3-5 of the Packer Avenue Terminal is the best choice due to its berthing capabilities, bridge clearance, and rail facilities.

RECOMMENDATION

We recommend use of the Port of Philadelphia for deploying at least a mechanized infantry brigade.

One portable rail ramp must be obtained.

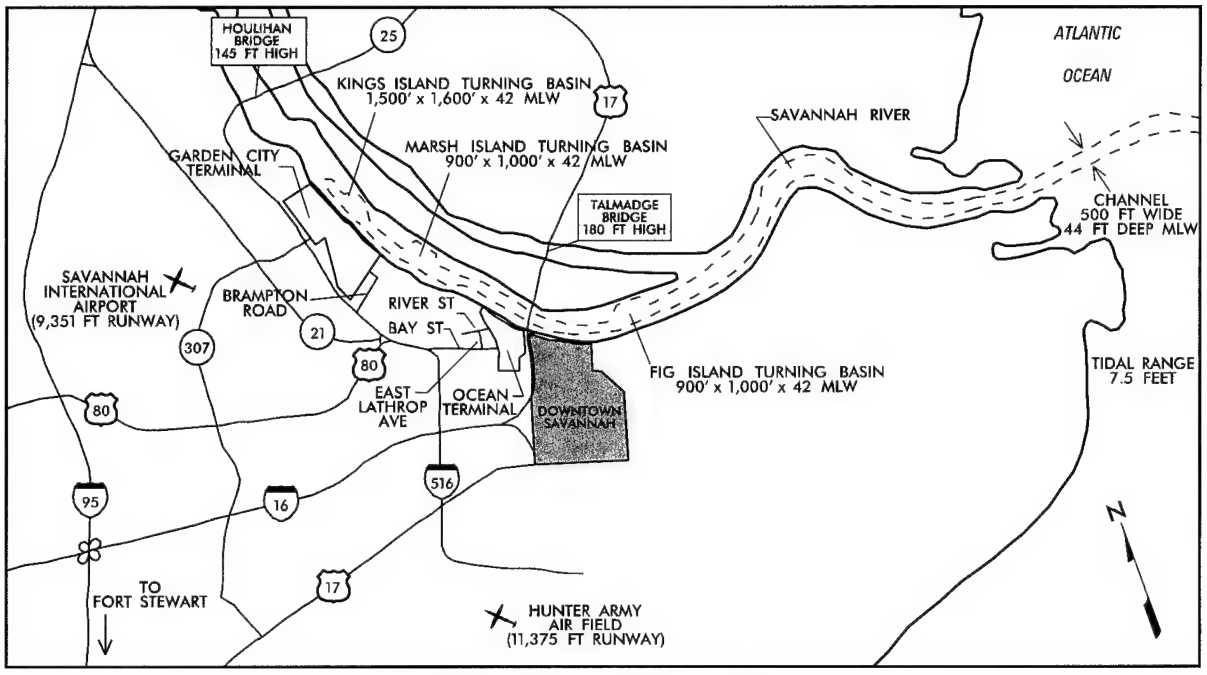
PORT OF SAVANNAH, GA

I. GENERAL DATA

TRANSPORTATION ACCESS

Water

The Port of Savannah is on the Savannah River, about 25 miles from the Atlantic Ocean. Its two main facilities, Ocean and Garden City Terminals, are about four miles apart. Silting is a serious problem and dredging is carried out on a continuous basis. Ships only pass under the Talmadge Bridge (US 17), which is 180 feet above the water at mean high water (MHW).



Water and Highway Access

Highway

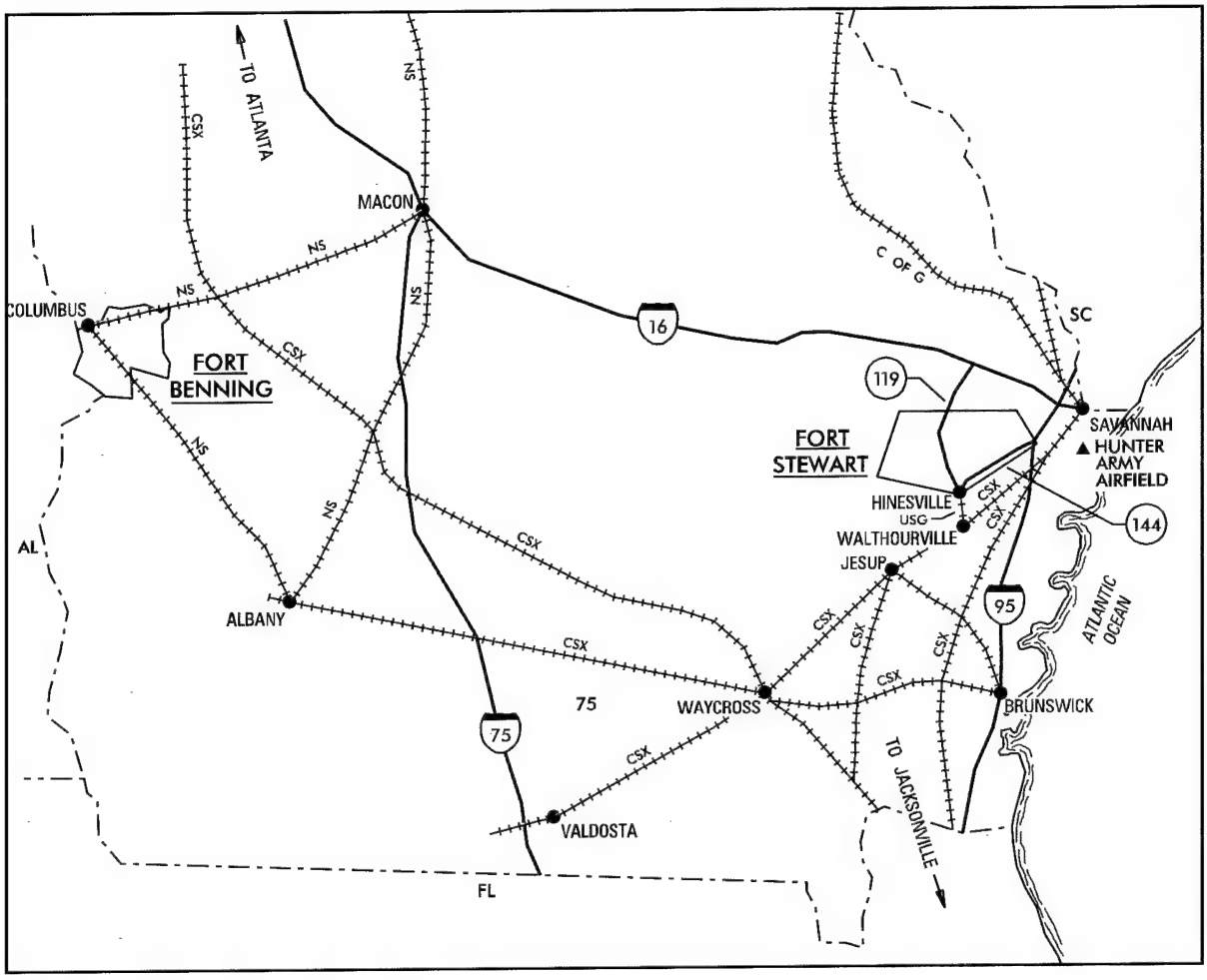
The major highway access to the port is Interstate Route 16 (I-16). I-16 joins I-75 to Atlanta, Georgia. Just a few miles from Savannah, I-16 joins I-95, the major north-south corridor. To reach Ocean Terminal from I-16, exit onto four-lane I-516, to Bay Street/US17, then to two-lane East Lathrop Avenue to the main gate on River Street.

To access the Garden City Terminal, take I-95 to Highway 21 south exit to Georgia Route 307 to Gate 1. From I-16, take I-516 to Georgia Route 25 to Brampton Road to Gate 2.

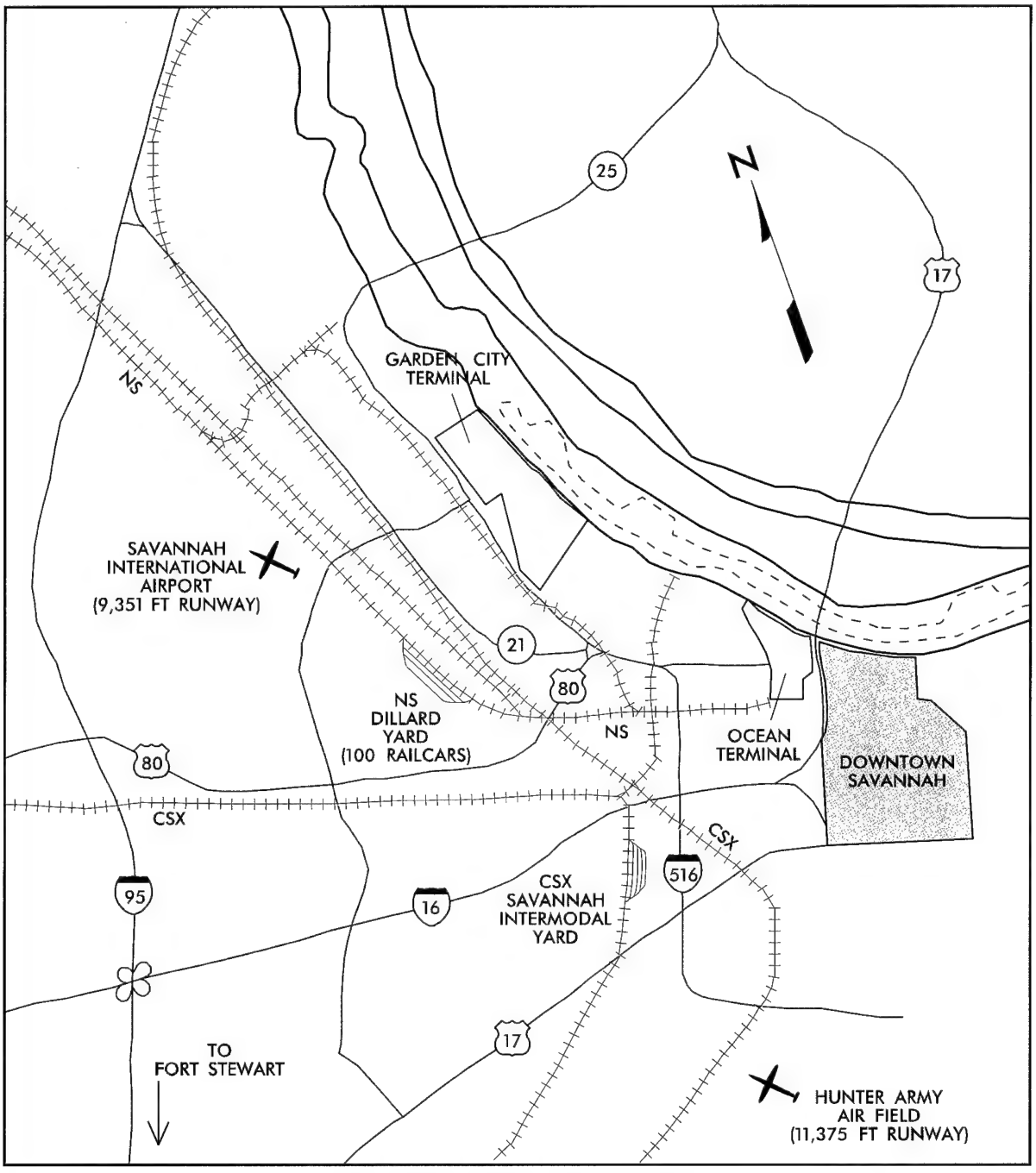
Rail

Rail reception at the Port of Savannah is good. The Norfolk Southern (NS) and CSX provide rail service to Savannah. The Savannah State Docks Railroad, owned by the Georgia Ports Authority, performs switching at the Garden City Terminal with three switch engines.

CSX and NS offsite facilities, 5 miles from the port, provide additional storage for 4,000 railcars. These facilities also perform intermodal operations.



Rail Access



Air Access and Local Railyards

Airports

Savannah International Airport is 5 miles west of Garden City Terminal. The airport is about 10 miles northwest of Ocean Terminal. The nearest military airfield is Hunter Army Airfield, just south of downtown Savannah.

PORT FACILITIES

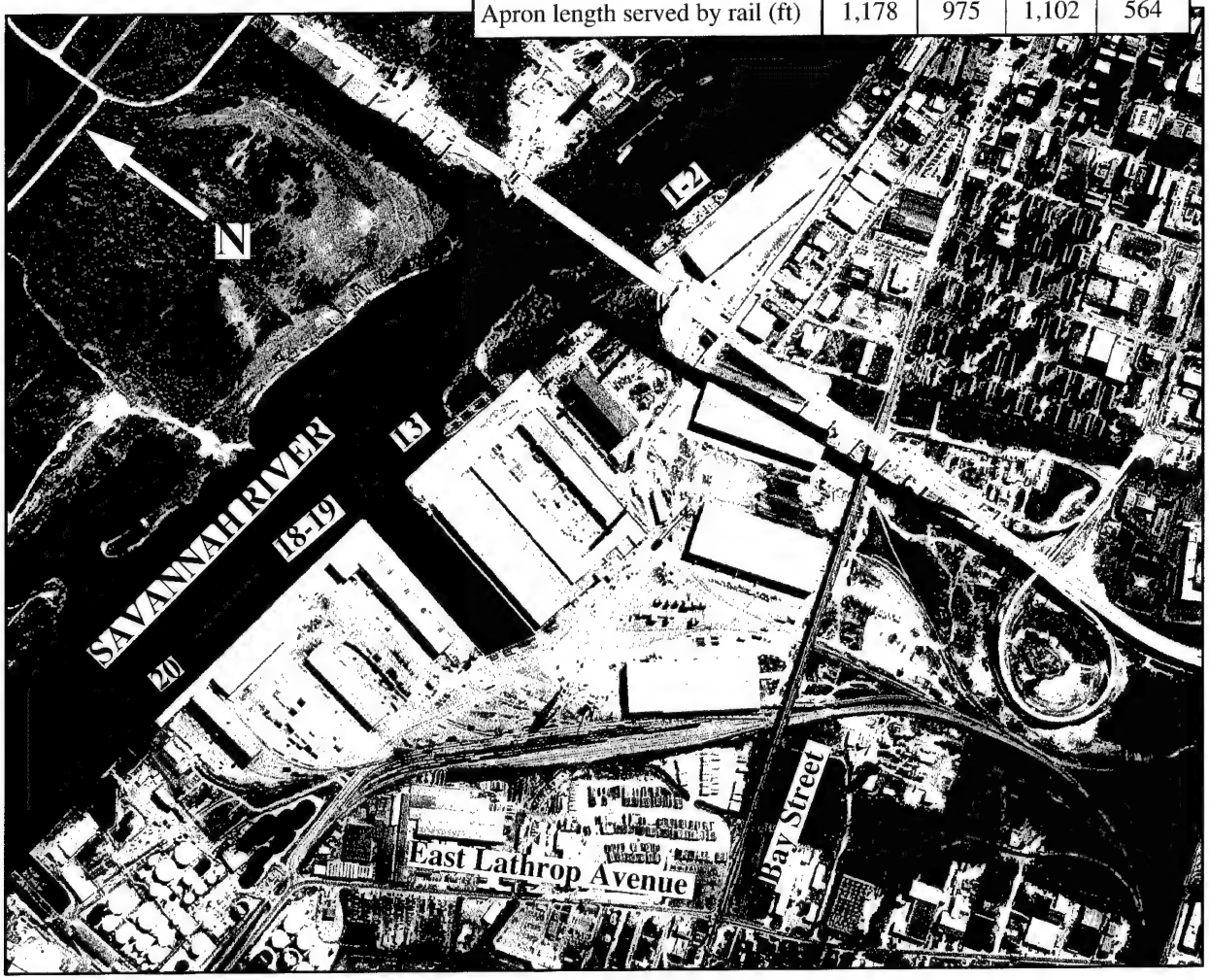
Berthing

Ocean Terminal is generally a breakbulk terminal, with limited container capability. The slip at Ocean Terminal has silted and gotten to be too shallow for anything but barge loading.

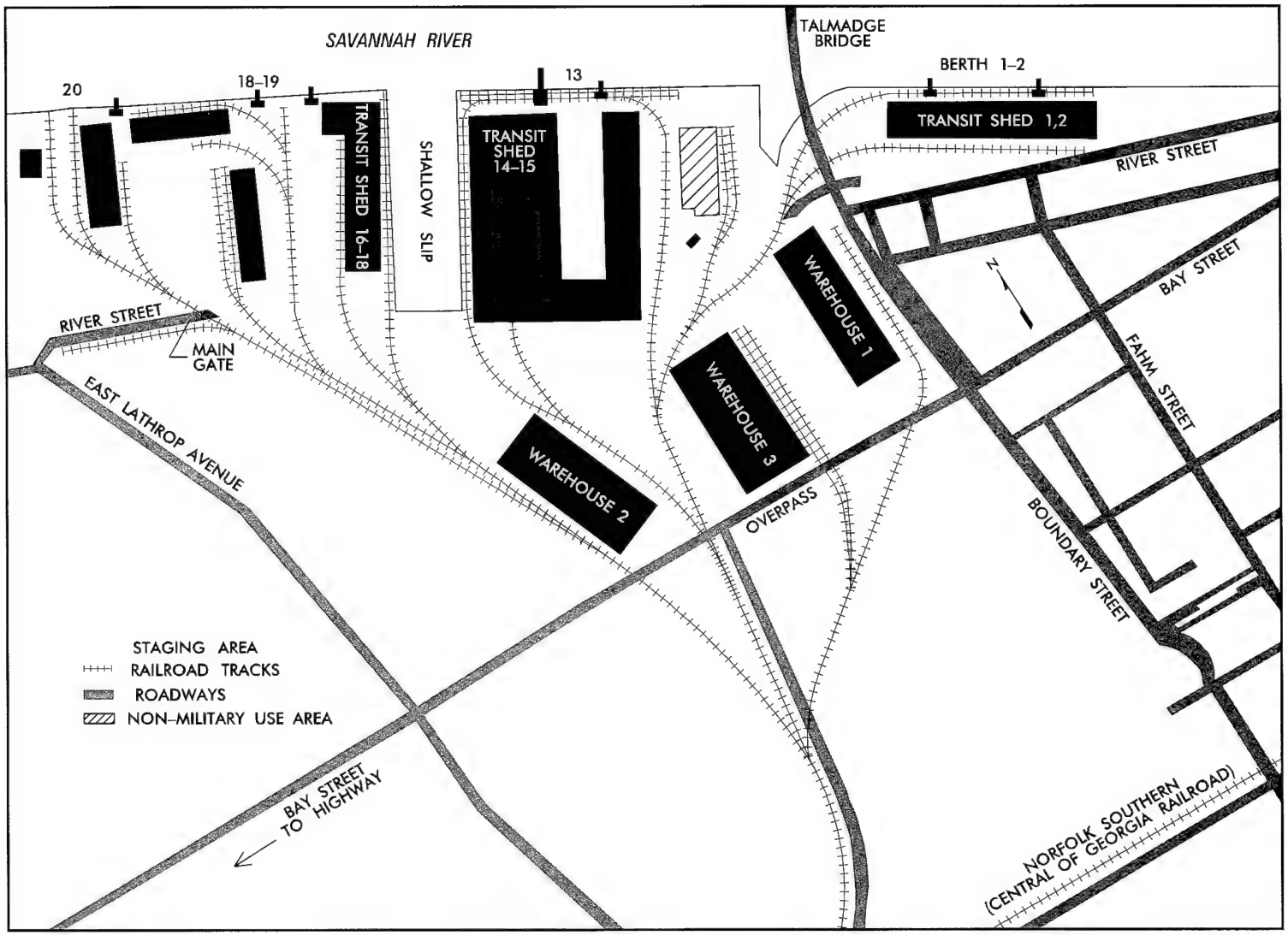
Pier construction is concrete piles, with a sheet-steel bulkhead. Fendering is usually timber, and the surface is generally concrete. All terminals have lighting for night operations.

BERTHING CHARACTERISTICS OF OCEAN TERMINAL

Characteristics	Berths			
	1-2	13	18-19	20
Length	1,178	975	1,102	564
Depth alongside at MLW (ft)	42	42	42	38
Deck strength (psf)	1,000	1,000	1,000	1,000
Apron width (ft)	57	Open	57	57
Apron height above MLW (ft)	15	15	15	15
Number of container cranes	0	1	0	0
Number of wharf cranes	2	1	2	1
Apron lighting	Yes	Yes	Yes	Yes
Straight-stern RORO facilities	No	No	No	No
Apron length served by rail (ft)	1,178	975	1,102	564



Ocean Terminal

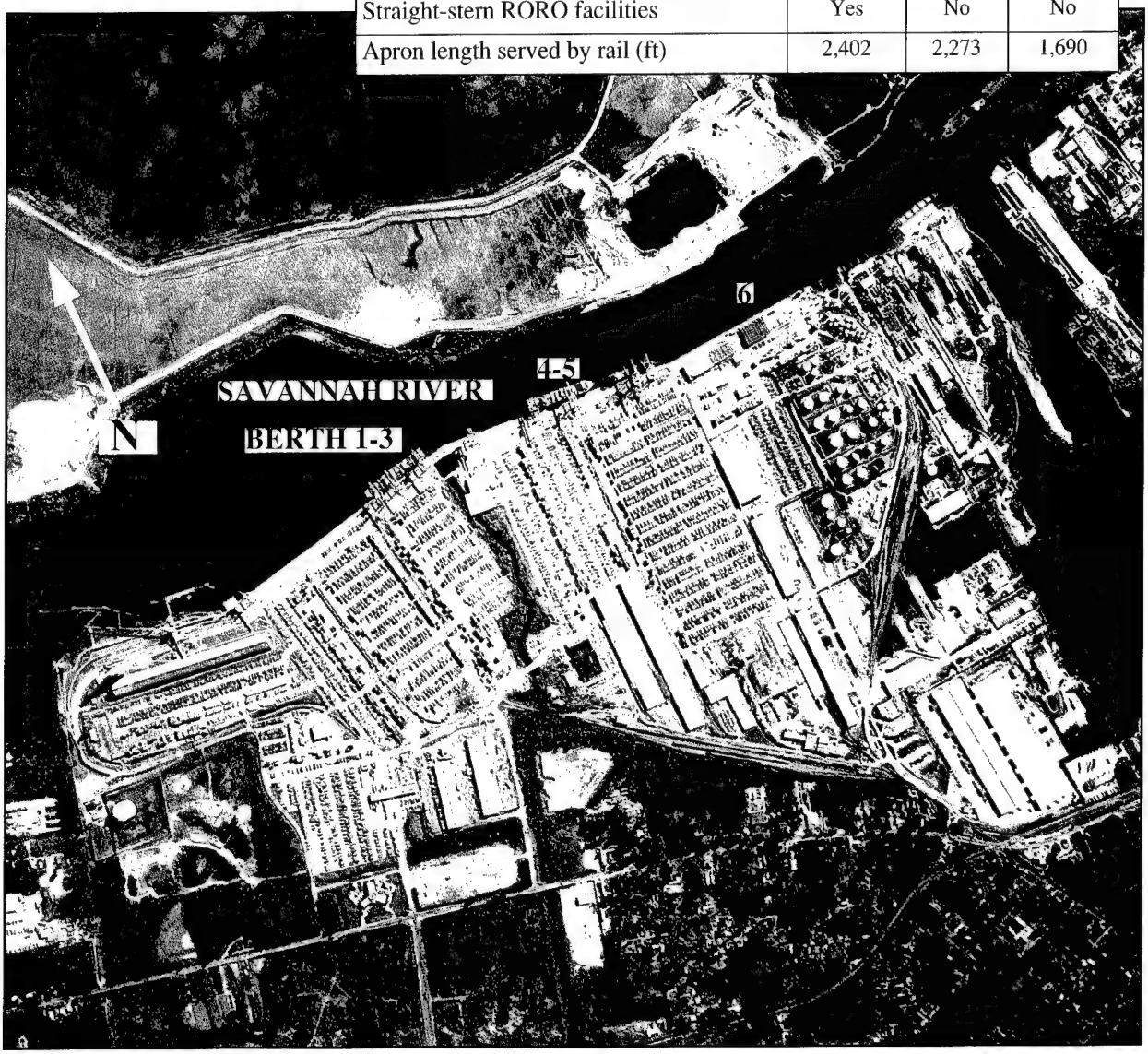


Ocean Terminal

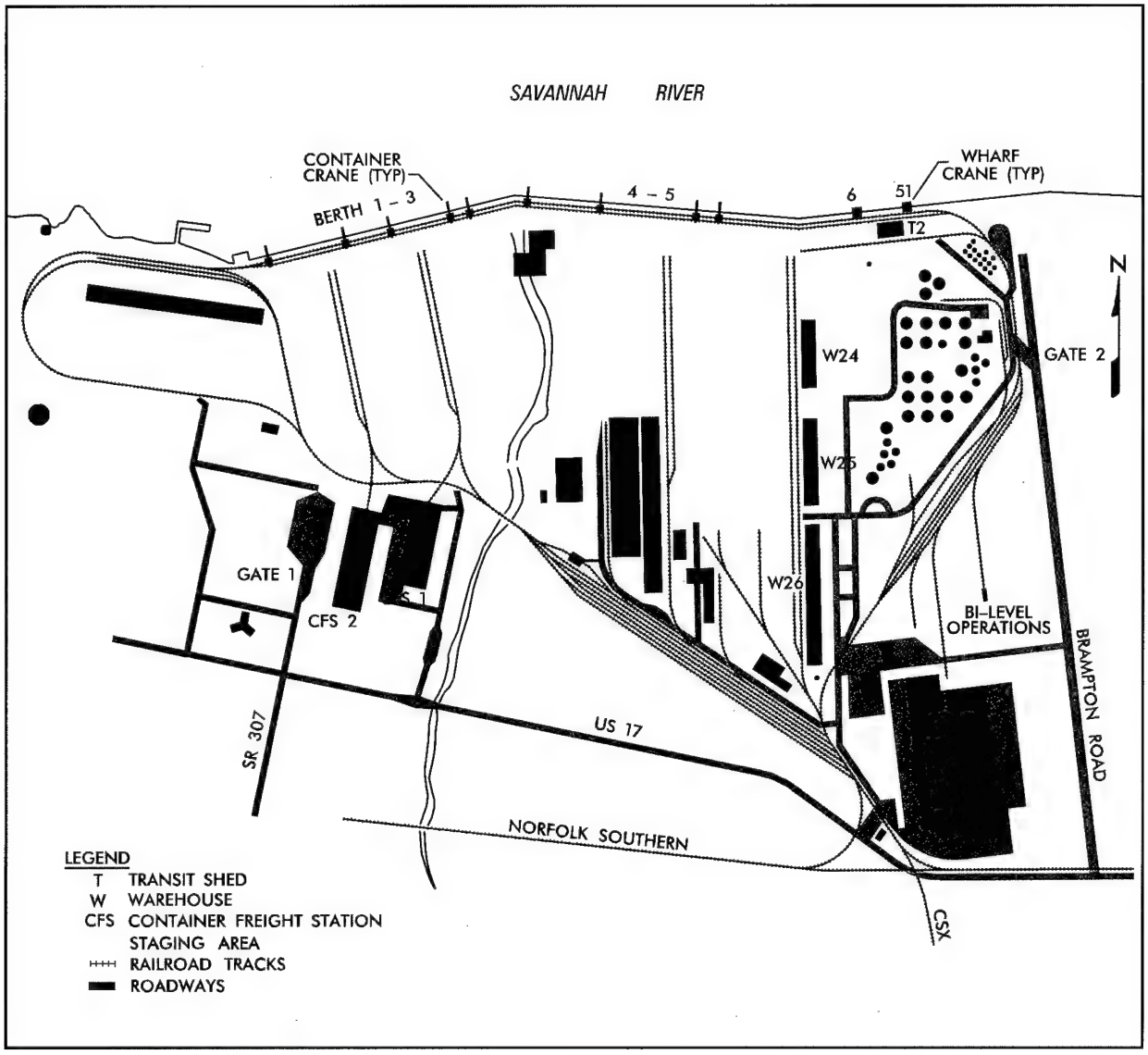
Garden City Terminal is primarily a container facility with cranes, container handlers, and open aprons. The far south end is used for liquid bulk cargoes, and is not considered in this report for military operations.

BERTHING CHARACTERISTICS OF GARDEN CITY TERMINAL

Characteristics	Berths		
	1-3	4-5	6
Length (ft)	2,402	2,273	1,690
Depth alongside at MLW (ft)	42	42	42
Deck strength (psf)	1,000	1,000	1,000
Apron width (ft)	Open	Open	Open
Apron height above MLW (ft)	15	15	15
Number of container cranes	5	3	2
Number of wharf cranes	0	0	0
Apron lighting	Yes	Yes	Yes
Straight-stern RORO facilities	Yes	No	No
Apron length served by rail (ft)	2,402	2,273	1,690



Garden City Terminal

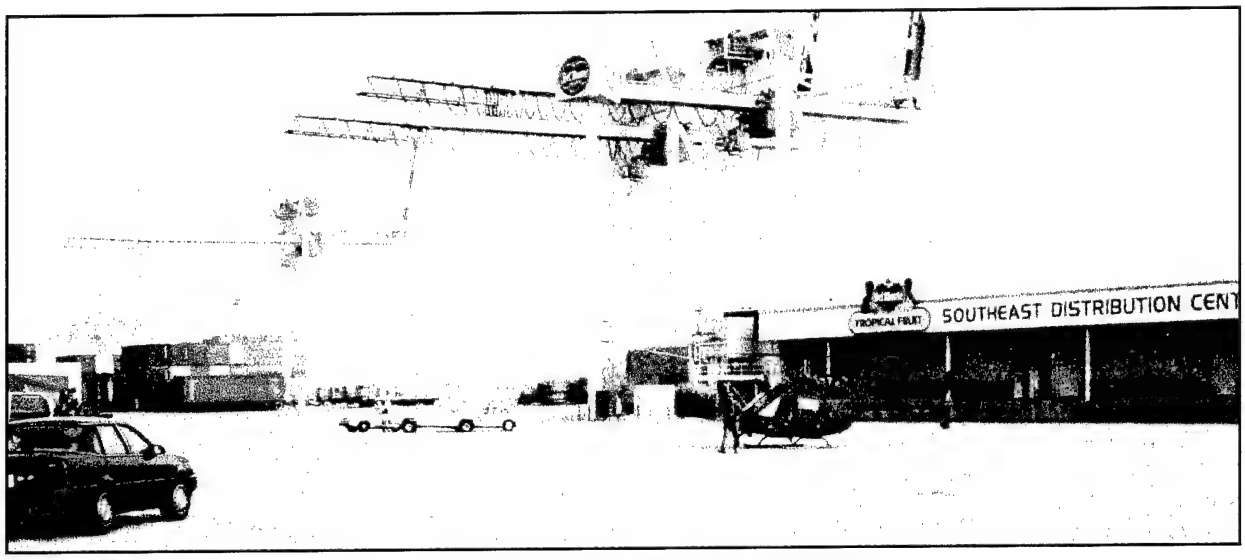


Garden City Terminal

Staging

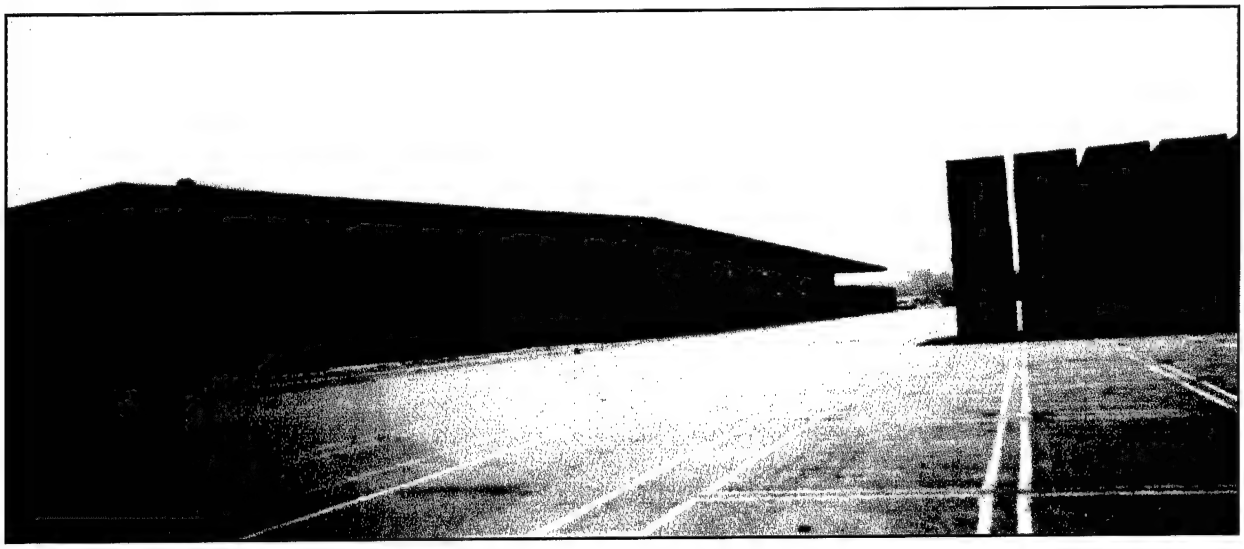
a. ***Open Staging***. The Ocean Terminal has 82 acres of open staging. The Garden City Terminal has about 314 acres of open staging. Open staging is mostly used for containers.

The open area inland of berth 6 has supported helicopter operations in previous military operations



Helicopter Operations Inland of Berth 6, of the Garden City Terminal

b. ***Covered Staging***. The two terminals have about 20 transit sheds and warehouses. These buildings provide nearly three million square feet of covered staging. Other buildings are set up for refrigeration, manufacturing, or repair operations, and would not support military operations.



Covered Staging at the Garden City Terminal

Rail

The Garden City Terminal has two pairs of rail spurs at berth 1-3 that have been used to offload railcars of military equipment.

NS and CSX tracks connect with the port tracks at Garden City Terminal. Savannah State Docks Railroad, which is owned by the port, performs onsite switching. Garden City can stage about 600 railcars.

Ocean Terminal does not have onsite railcar storage, but the adjacent NS Railyard can hold 600 railcars.

Norfolk Southern Railyard inland from Ocean Terminal

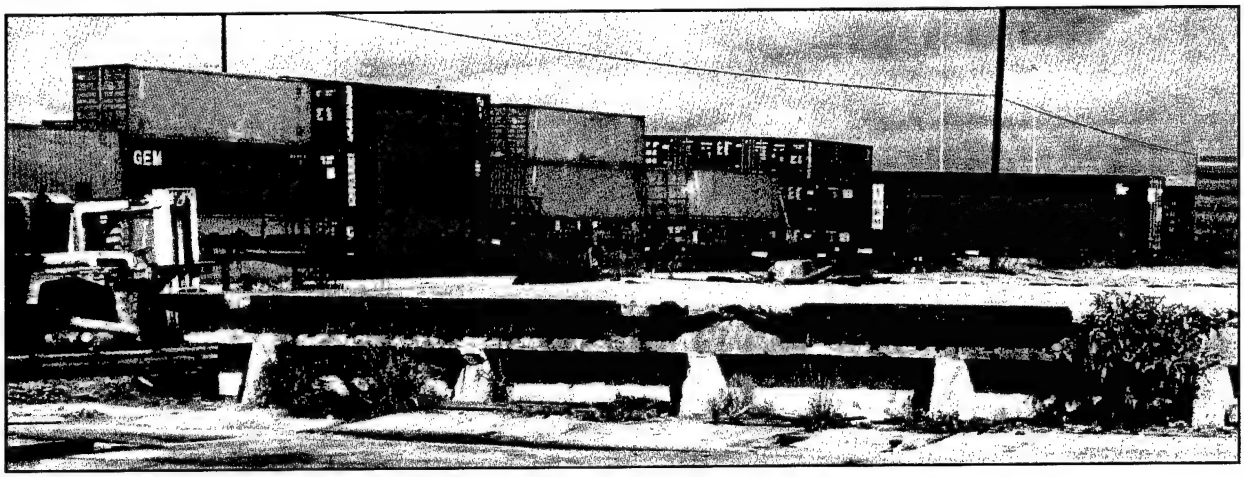
Highway

Both Terminals have well maintained roads. There are no clearance problems. Most roads are four-laned.

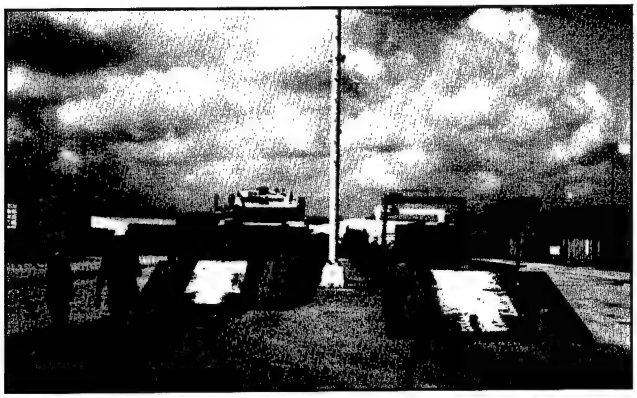
UNLOADING/LOADING POSITIONS

Ramps. The port has no permanent rail ramps, but Garden City Terminal has two portable end ramps available. On occasion, railcars have also been converted to work as ramps by removing the truck under one end. The intermodal spurs at Garden City berth 1-3 are good locations for portable end ramp operations. NS has one portable bilevel ramp that has been used at Garden City Terminal during deployments and exercises.

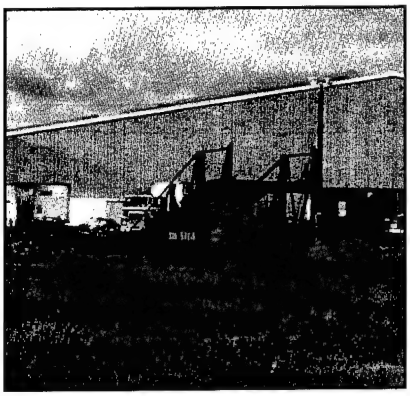
The only fixed truck ramp is at the Garden City Terminal near berth 6. This ramp can handle three trucks at a time. There are numerous portable ramps capable of offloading equipment on flatbed semitrailers.



Fixed-Truck Ramp at Garden City Terminal



MTMCTEA Designed Portable Ramps at Garden City Terminal



Rail-Mounted Bilevel Ramp

Docks. All together, the port has 440 trucks and 186 boxcar handling positions. The two container freight station buildings at Garden City Terminal provide more than a third of the truck docks for stuffing and unstuffing containers.

MARSHALING AREAS

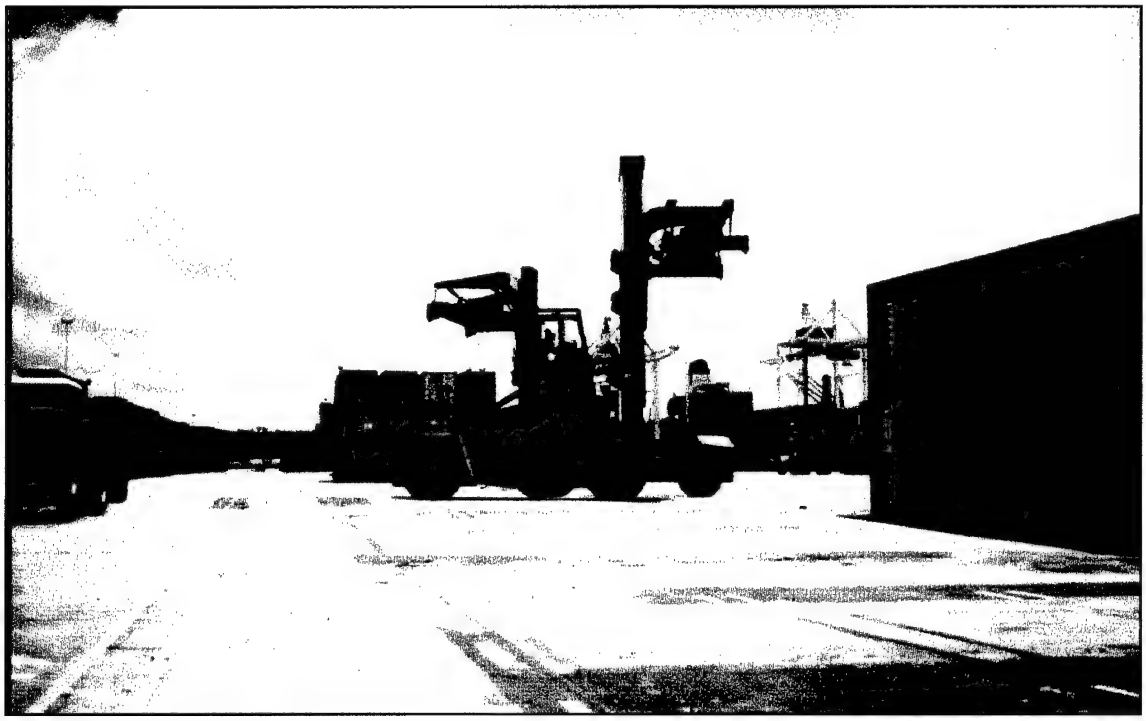
Within Port. No marshaling areas exist. All open areas within the terminals are required for staging military or commercial cargo.

Hunter Army Airfield. The airfield is less than 30 minutes from the port. It has three fixed rail end ramps with tangential lengths from 1,400 to 2,200 feet, and a portable bilevel ramp. These facilities are used to support airlift deployments. and may not be available for sealift support. All together, the airfield has at least 50 acres of potential marshaling areas.

Fort Stewart. Fort Stewart is about 40 miles west of the port. It has ten fixed rail end ramps with tangential lengths from 1,000 to 8,100 feet. All together, the installation has at least 75 acres of potential marshaling areas, in several areas.

MATERIAL HANDLING EQUIPMENT (MHE)

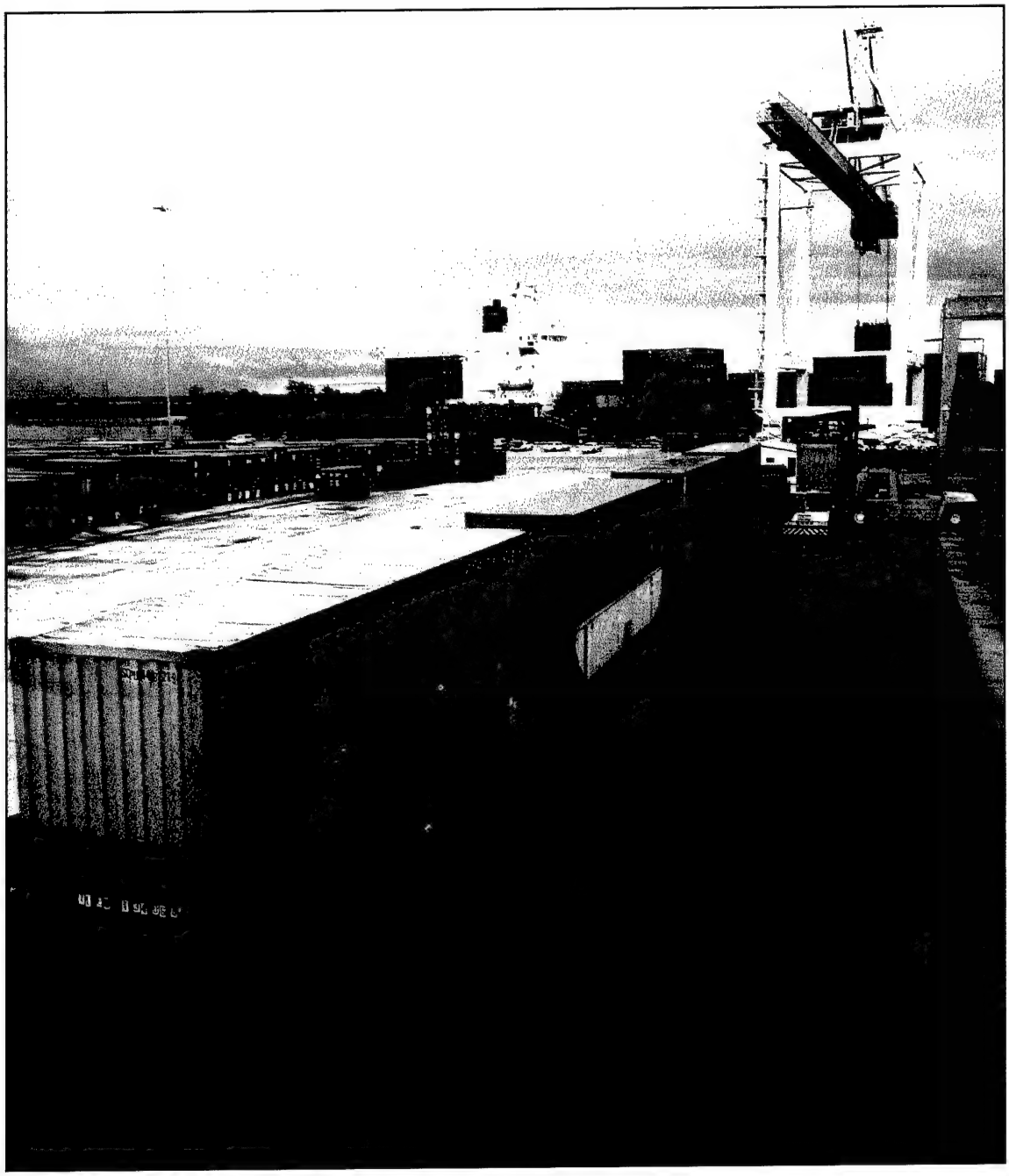
TYPE OF EQUIPMENT	CAPACITY (STON)	OCEAN TERMINAL	GARDEN CITY
Transtainers	45	0	13
Mobile Cranes	35	0	1
Container Handlers	40-45	3	15
Switch Engines	-	3	



Container Handlers at Garden City Terminal

INTERMODAL FACILITIES

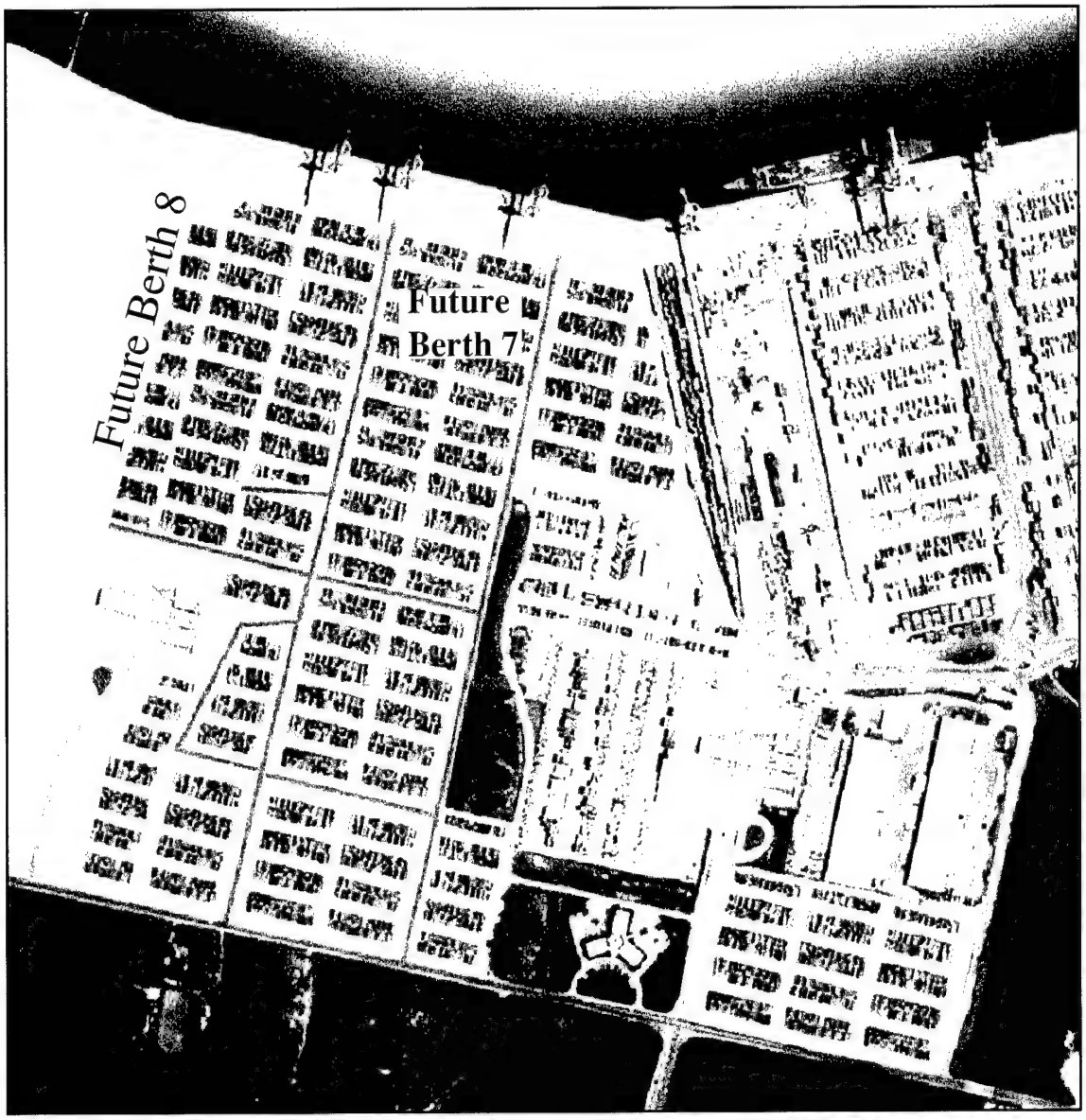
Most of the port intermodal traffic is handled at Garden City Terminal around-the-clock 6 days per week. NS performs limited TOFC/COFC operations at their Dillard Yard, about 3 miles from the Garden City Terminal. CSX also performs intermodal operations at their Savannah Intermodal Yard, about 5 miles from Garden City Terminal.



Intermodal Operations at Garden City Terminal

FUTURE DEVELOPMENT

The port has already begun developing berth 7 with 147 acres of container staging, just west of the Garden City Terminal.



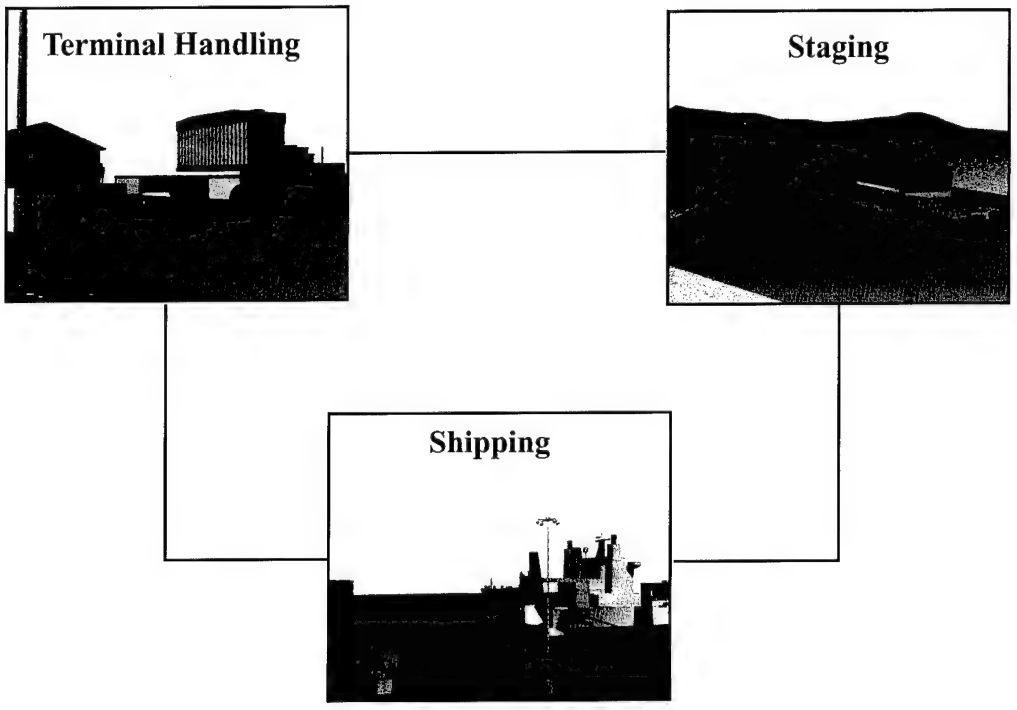
Future Berth 7 at Garden City Terminal

The port also hopes to develop 2,200 acres about 5 miles above the Garden City Terminal, within a mile of I-95. Mulberry Grove may develop into eight container berths, with each berth supported by 100 acres of paved open storage. Construction is expected to begin in the late 1990's.

II. THROUGHPUT ANALYSIS

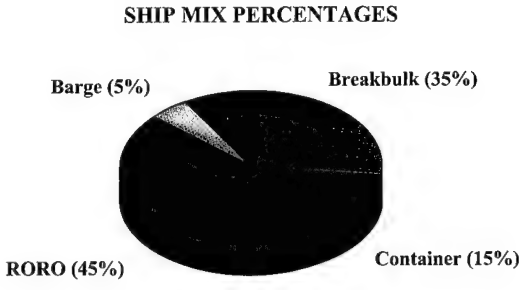
GENERAL

This section evaluates the throughput capability of the Port of Savannah using the port operational performance simulator (POPS) computer model. The model is based on a weak- link analysis in which each subsystem is analyzed separately and then compared to find the least capable subsystem. The weakest subsystem defines the maximum throughput capability of the terminal. The model yields throughput capability values for three subsystems - shipping, staging, and terminal processing/handling - in terms of measurement tons (MTON) per day.



Terminal Throughput Subsystems

This analysis assumes a maximum of 80% of the port facilities can be made available at any one time. For this reason, we ran all port analyses using an 80% facility use factor. Also, the ship mix is based on Desert Shield and Desert Storm statistics. We weighted the percentages to adjust for differences in cargo deadweights and expectations for future deployments.



TERMINAL RECEPTION/HANDLING

Highway. Brampton Road and River Street provide access to Garden City and Ocean Terminal main gates, respectively. Each road has two lanes. The road network in and out of the terminals, including the gate processing of vehicles, should handle about 250,000 MTON of equipment and supplies per day.

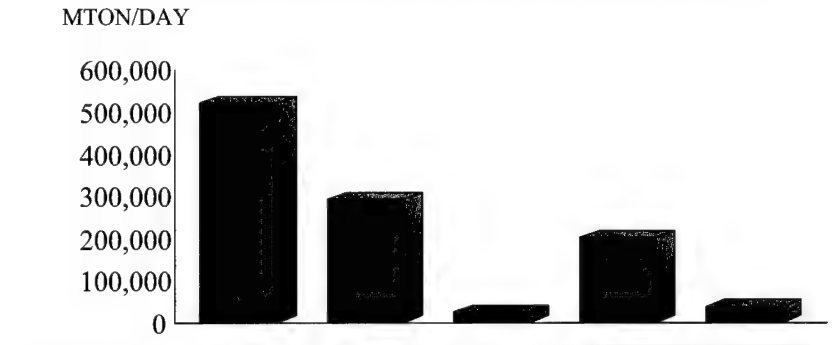
Roadable vehicles in convoys will process directly to the staging areas. Vehicles on commercial or military flatbed trailers without integral ramps will offload at portable ramps. Our analysis assumes two portable ramps are available in open areas, in addition to the three-truck fixed-ramp at Garden City Terminal. These ramps could offload about 23,000 MTON from flatbed trailers per day.

Supplies in van semitrailers will proceed to the 440 van-handling positions. These docks can offload more than 200,000 MTON of van semitrailer-shipped material per day. This report assumes seven container handlers are available for chassis operations. These container handlers can offload about 37,000 MTON of chassis cargo per day.

Assumptions for Chart Below

Terminal	Ocean	Garden City
Fixed Ramp	0	3
Portable Ramp	1	1
Van Positions	180	260
Container Handlers	1	6

HIGHWAY RECEPTION/HANDLING CAPABILITY



SUBSYSTEMS	HIGHWAY	GATES	END-RAMPS	DOCKS	CONTAINERS
OCEAN	350,000	80,000	4,800	81,000	7,500
GARDEN CITY	170,000	210,000	19,000	120,000	30,000

Rail. Rail reception at the port is fair, with two major railroad companies accessing the Savannah area. The infrastructure could support 20 percent additional traffic.

Of the two terminals, the Garden City Terminal has the best rail storage. This analysis uses five portable or temporary rail end ramps, each have 1,000 to 1,200 feet of tangential track. The container storage areas at the Garden City Terminal could support most or all of these ramps. Ocean Terminal could support portable rail ramp operations along several sheds.

This analysis also assumes seven container handlers are available.

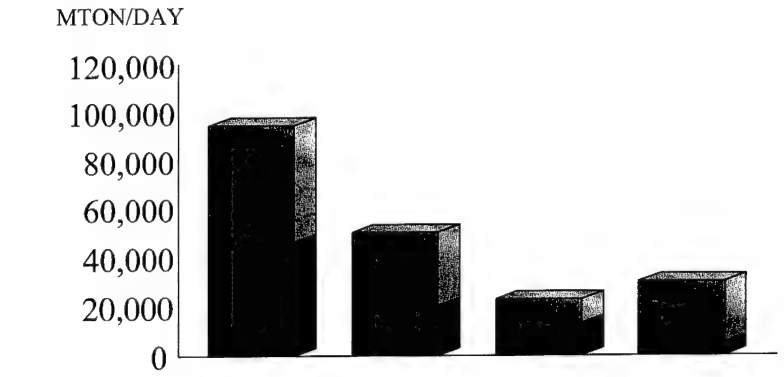
Railcar Delivery

Terminal	Ocean	Garden City
Trains Per Day	4	4
Train Length (railcars)	60	60

Assumptions for Chart Below

Terminal	Ocean	Garden City
Fixed Ramp	0	0
Portable Ramps	2	3
Boxcar Positions	95	91
Container Handlers	1	6

RAIL RECEPTION/HANDLING CAPABILITY



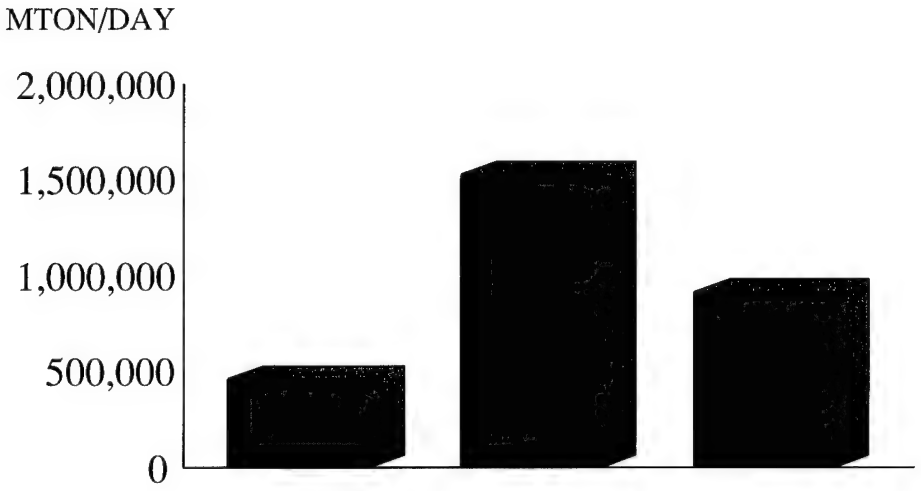
SUBSYSTEMS	TRACKAGE	END-RAMPS	DOCKS	COFC
OCEAN	46,000	20,000	13,000	4,800
GARDEN CITY	49,000	30,000	9,800	25,000

STAGING

The Ocean Terminal has about 82 acres of open staging area. The Garden City Terminal has about 314 acres. Both terminals combined have about three million square feet of covered storage. Most of it is at the Ocean Terminal.

The chart below indicates the staging throughput, assuming only one ship type at the terminal. If combination ships or multiple ship types operate at the terminal/s, a portion of each ship type is totaled for the overall staging throughput.

OPEN STAGING CAPABILITY



VESSEL TYPE	RORO	CONTAINERS	BREAKBULK
OCEAN	43,000	230,000	190,000
GARDEN CITY	420,000	1,300,000	730,000

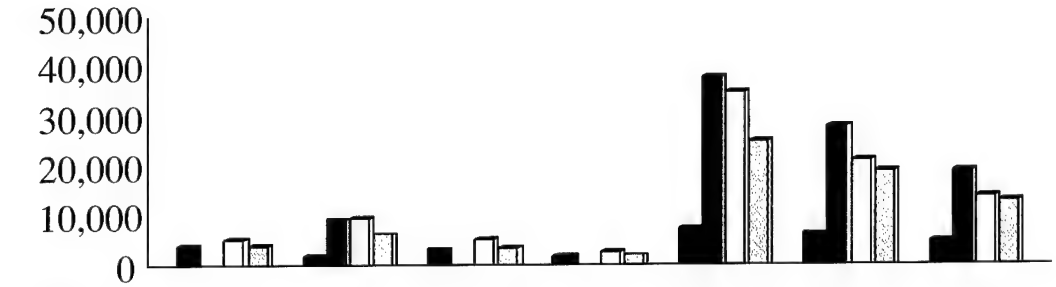
SHIPPING

Throughputs for each berth are shown below. They are based on various factors including MHE used, loading, operational, and berth usage rates as well as berth/ship compatibility. The parameters used for the POPS analysis are provided in the appendix.

CONVERSION FACTORS	
Breakbulk:	**.4 STON per MTON**
RORO:	**.25 STON per MTON**
Containers:	**.4 STON per MTON**

BERTH THROUGHPUT CAPABILITY

MTON/DAY



BERTH	O1-2	013	O18-19	O20	GC1-3	GC4-5	GC6
BREAKBULK	3,900	1,900	3,400	1,900	7,400	6,400	4,800
RORO	0	9,400	0	0	38,000	28,000	19,000
CONTAINER	5,300	9,600	5,300	2,700	35,000	21,000	14,000
MIXED	4,000	6,400	3,700	2,100	25,000	19,000	13,000

O = Ocean Terminal
GC = Garden City

The type of ship preferred at each berth is based on the methodology described in the appendix. The evaluation is based on a snapshot view of the current physical characteristics of the berths and the MHE available. The evaluation below gives no considerations for enhancements, such as equipment. The lower the number for a berth, the better the berth is suitable for the loading operation. The container berths at Garden City (1-3 and 4-5) are the best for all types of shiploading. Although the apron height limits the draft at low tide, these berths and berth 13 at the Ocean Terminal can support FSS loading. LMSRs can also load at these berths without restrictions.

PREFERENCE BERTH SELECTION			
BERTH	BB	**RORO**	**CNTNR**
Ocean			
1-2	5	-	-
13	4	3	3
18-19	6	-	-
20	7	-	-
Garden City			
1-3	1	1	1
4-5	1	1	1
6	3	4	1

SUMMARY OF BERTHING CAPABILITIES

Vessel	Berths O = Ocean Terminal GC = Garden City Terminal						
	01-2	013	018-019	020	GC1-3	GC4-5	GC6
Breakbulk							
C3-S-33a	2	1	2	1	4	4	3
C3-S-37c	2	1	2	1	4	4	3
C3-S-37d	2	1	2	1	4	4	3
C3-S-38a	2	1	2	1	4	4	3
C4-S-1a	2	1	1	1	4	3	2
C4-S-lqb and 1u	1	1	1	c	4	3	2
C4-S-58a	1	1	1	c	4	3	2
C4-S-65a	2	1	1	1	4	3	2
C4-S-66a	2	1	1	1	4	4	2
C4-S-69b	1	1	1	c	3	3	2
Seatrain							
GA and PR-class	2	1	1	1	4	3	2
Barge							
LASH C8-S-81b	1	1	1	c	2	2	2
LASH C9-S-81d	1	1	1	c	2	2	1
LASH lighter	8	6	7	4	17	16	12
SEABEE C8-S-82a	1	1	1	a,c	2	2	1
SEABEE barge	5	4	5	2	12	11	8
RORO							
Comet	d,o	d,i,j	d,o	d,o	i,j	d,i,j	d,i,j
C7-S-95a/Maine-class	b	1	b	b,c	3	2	2
Ponce-class	b,h	h	b,h	b,c,h	h	h	h
Great Land-class	b,h	h	b,h	b,c.h	h	h	h
Cygnus/Pilot-class	b	1	b	b,c	3	3	2
Meteor	d,o	d,i,j	d,o	d,o	i,j	d,i,j	d,i,j
AMEagle/Condor	b	i,j	b	b,c	i,j	i,j	i,j
MV Ambassador	d	d	d	d	4,m	d	d
FSS-class	b	l,i	b	b,c	2,i	2,i	l,j
Cape D-class	b	i,j	b	b,c	i,j	i,j	i,j
Cape H-class	b	i,i	b	b,c	3,i	2,i	2,i
LMSR	b	i,i	b	b,c	2	2	1
Container							
C6-S-qw	1,e	1	1,e	c,e	3	3	2
C7-S-68c	1,e	1	1,e	c,e	3	3	2
C8-S-85c	1,e	1	1,e	c,e	2	2	1
Combination							
C5-S-78s	1,e	1	1,e	c,e	3	3	2
C5-S-37e	1,e	1	1,e	c,e	3	3	2

a=vessel draft limited to berth depth
b=inadequate apron width
c=inadequate berth length
d=no straight stern-ramp facilities
e=no container-handling equipment
f=shallow berth, adequate anchorage depth
g=inadequate channel depth
h=no shore-based ramps available
i=insufficient ramp clearance at low tide
j=insufficient ramp clearance at high tide
k=excessive ramp angle at low tide
m=excessive ramp angle at high tide
n=parallel ramp operation only
o=too narrow apron for side-ramp

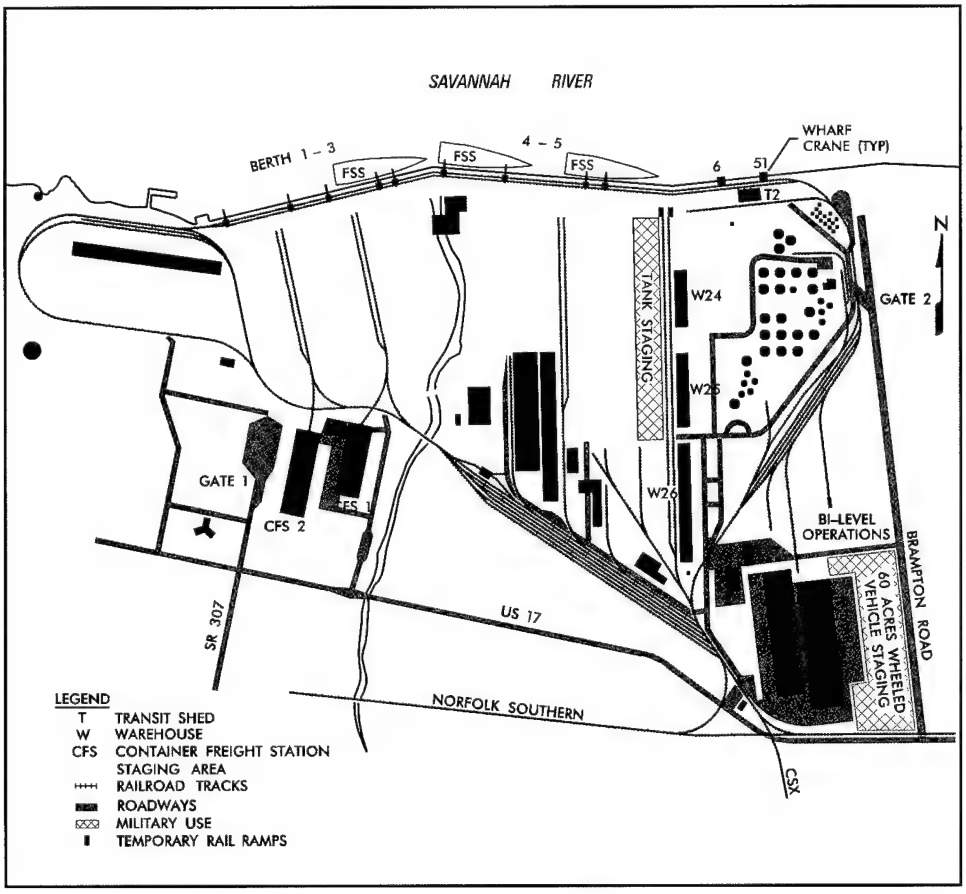
Notes: Ramp clearance and ramp angle based on maximum vessel draft
( ) indicates vessels assigned by analyst

III. APPLICATION

GENERAL

This section of the report will evaluate the port's throughput capability for deploying a notional mechanized infantry division using primarily FSS vessels. The August 1994 revision for the Planning Orders Digest, issued by MARAD, provided agreements for military use of the Port of Savannah. Although these agreements expired 1 July 1995, we expect they will be renewed without significant change, until 15 June 1996. Past military operations have been at the Garden City Terminal. We expect future military vehicles will stage at Garden City due to the 1,000 feet of berthing in the Planning Order, however some vehicles will convoy to Ocean Terminal.

Current Planning Orders for Port of Savannah		
	Ocean Terminal	**Garden City Terminal**
Berths	1,000 ft	2,000 ft
Covered Storage	Adjacent shed	Adjacent sheds
Open Staging	None	23 acres



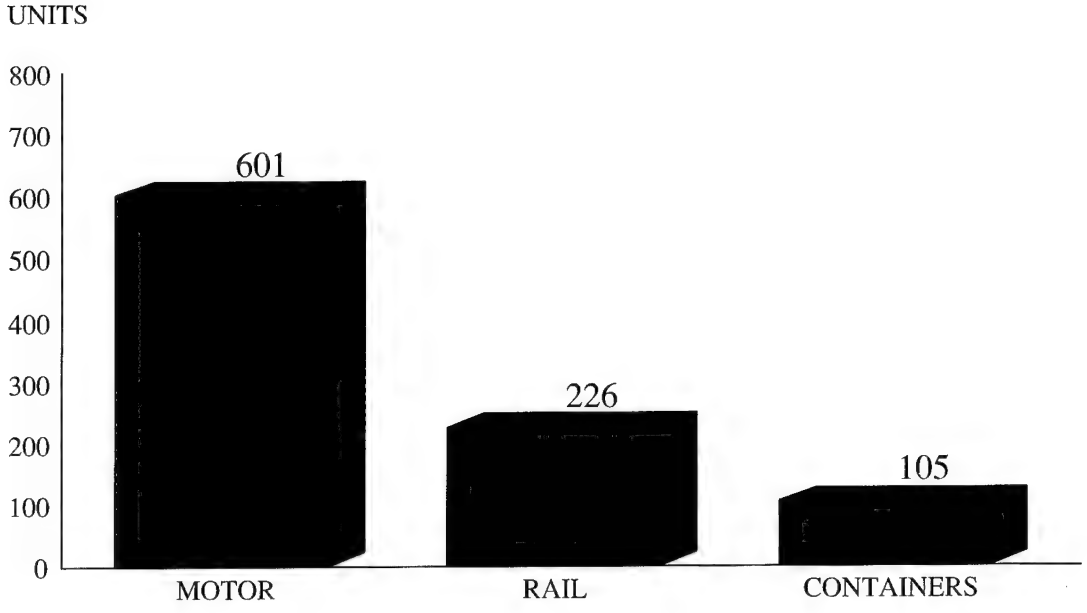
Facilities that may support military operations, if available.

REQUIREMENTS

The likely requirement for the Port of Savannah is to deploy a notional mechanized infantry division in six days of reception and throughput. The division has to move about 7,800 vehicles and 630 containers. The movement to the port will require 1,356 (226 per day) railcars using the convoy/rail option. Under this option, about 3,606 roadable vehicles (601 per day) would be driven into the gate, towing 2,274 trailers (379 per day). About 105 containers would arrive per day.

MECHANIZED INFANTRY DIVISION	
Total Equipment	
Volume	280,000 MTON
Weight	95,000 STON
Area	1,400,000 SQ FT
Vehicles	7,800
Containers	630

DAILY REQUIREMENTS



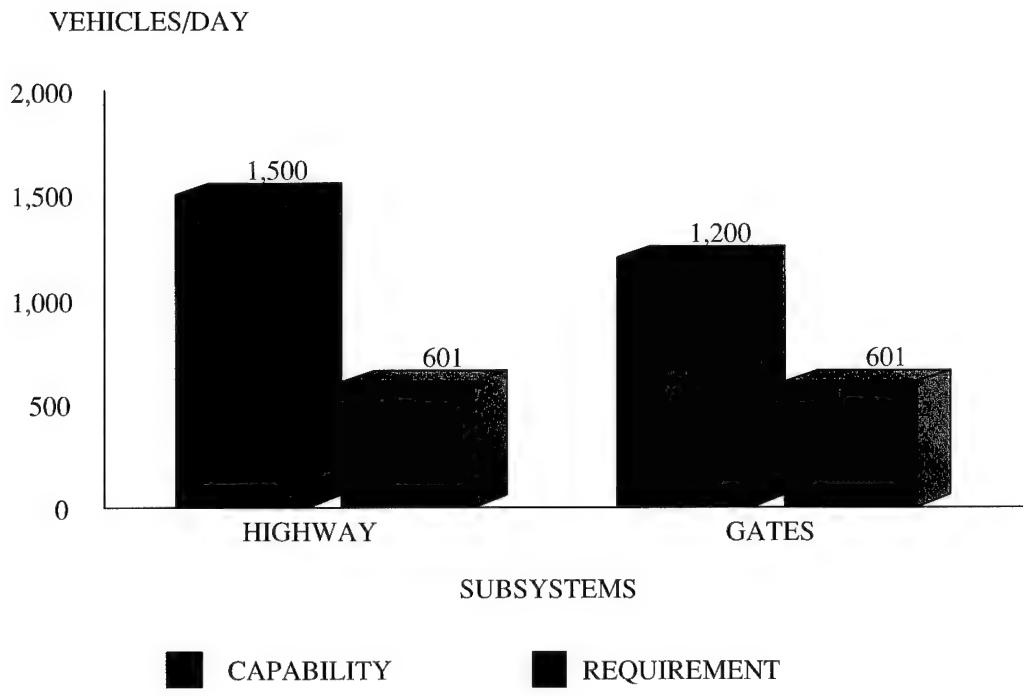
TERMINAL INPROCESSING/HANDLING

HIGHWAY

Terminal operators at Garden City Terminal should open the gate on Brampton Road for military vehicles and equipment arriving by convoy. Brampton Road offers access from Georgia Route 25. This arrangement allows unimpeded reception of military traffic into the terminal. Both the access roads and gate processing subsystems could handle more than 1,500 and 1,200 additional vehicles per day, respectively.

PSA personnel direct commercial or military vehicles carrying other vehicles to the three-truck fixed ramp adjacent to transit shed 1 for unloading. This fixed truck ramp could offload at least 300 non-roadable vehicles/equipment from flatbed trailers per day.

HIGHWAY INPROCESSING CAPABILITY



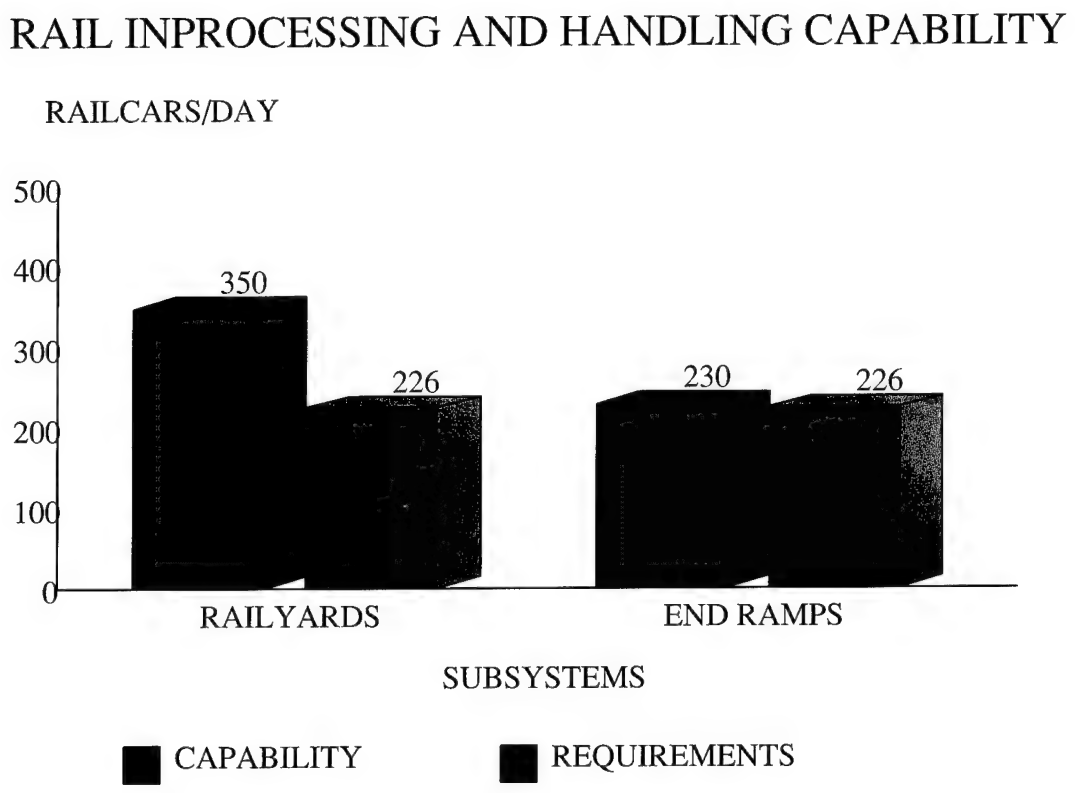
RAIL

Both NS and CSX serve the Garden City Terminal. CSX serves Fort Benning and NS serves Fort Benning.

These carriers will need to move four trains per day (about 60 railcars per train) from the forts to the port. These carriers can meet this demand if railcars are available.

The terminal has two large interchange yards with a holding capacity of about 600 railcars. By applying an operational factor of 60 percent, these railyards can process more than 350 railcars daily. Once arrived, switch engines can move as many as 46 cars at a time to the two tracks (23 per track) along warehouses 24, 25, and 26 for unloading. Experience shows that these two sites could easily offload the 46 railcars every 4 hours or 230 per day (including switching time). Other rail offloading sites could be made available if needed. Another 20 cars (10 per track) can be worked on the double tracks located on berth 4-5. Cars here could be switched in/out at the same rate as those on the other tracks. With two more portable end ramps, support personnel could unload 100 additional railcars per day. These two positions would help prevent a slowdown in rail reception in the event of unforseeable circumstances.

The terminal uses a bilevel ramp to offload military vehicles from multilevel railcars. The ramp is on the rail spur leading into the large unpaved area east of the K-MART warehouse.

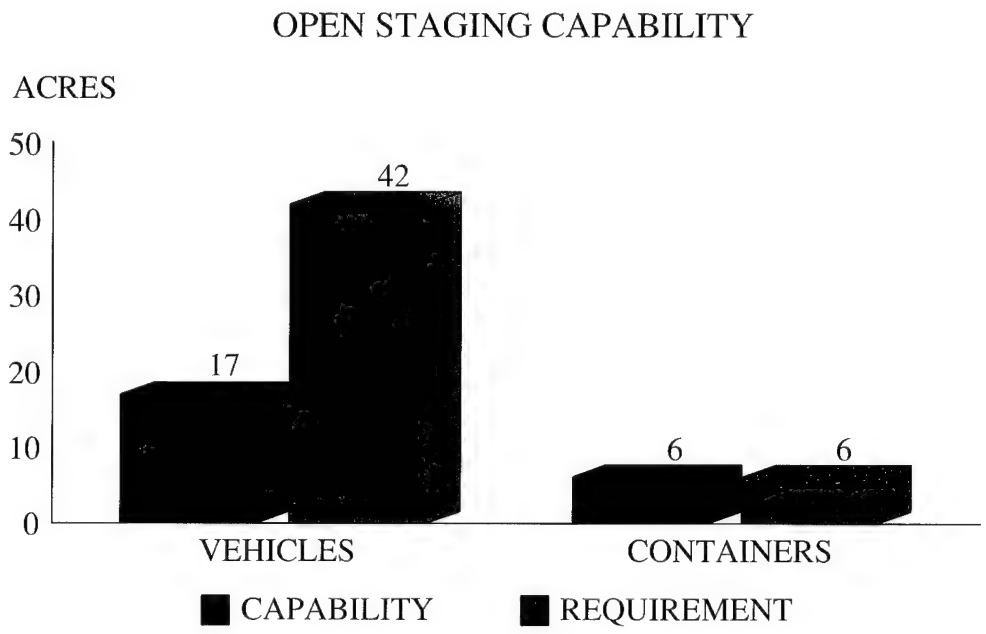


STAGING

This analysis assumes that current downsizing continues, and that nine FSS-sized ships will deploy an entire notional mechanized infantry division. Three ships will depart every 2 days. Because of this, the staging requirement is to support three sustained loading operations.

Although an FSS-load of cargo can be staged and loaded on 10 acres, 16 acres are required for sustained loading operations. Of these 16 acres, about 2 acres are required for the staging of the 70 containers for each FSS. The three simultaneous shiploading operations will require 48 acres of open staging, of which about 6 acres are dedicated to containers.

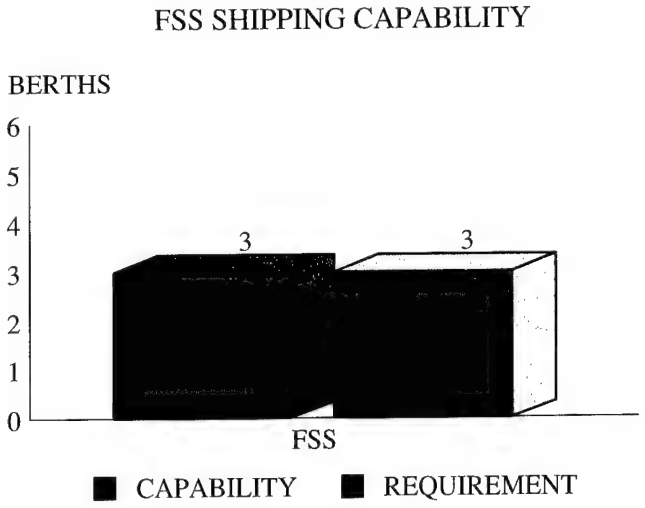
The Garden City Terminal contains over 300 acres of open staging area. The Planning Orders, however, only provide for 23 open acres of staging. This is not sufficient to meet the requirement of 48 acres.



Staging area within the terminal is more than adequate, if available. Military vehicles have staged on the 60 acres east of the K-MART warehouse. This area is unpaved and not suitable for heavy-tracked vehicles. Tanks have staged on the aprons.

SHIPPING

Although this analysis assumes that only nine FSS-sized ships can deploy the notional mechanized infantry division, the table below provides ship quantities for the current division size. The number of ships required depends on the shipping mix selected. The best ship mix would consist of all eight FSS ships, plus two Cape H RORO ships.



The Planning Orders provide berthing of two FSS-sized vessels at the Garden City Terminal, and one at the Ocean Terminal. Although the average apron width is too narrow, berth 18-19 of the Ocean Terminal can support side-ramp operations, if the vessel is carefully positioned. Although the Planning Orders divide the operations into two terminals, they meet the requirement to berth three FSS-sized vessels. The apron height of 15 feet above MLW might prevent RORO operations at low tide.

UNIT MOVEMENT REQUIREMENTS
MECHANIZED DIVISION

Loading Condition/Sample Ship Mix	Vessel Types			
	FSS (RORO/ Comb)	**Cape H (RORO/ Comb)**	**C3/C4 (Breakbulk)**	**C6/C7/C8 (Container)**
Minimum Containerization:				
All FSS*	8.00	1.90		
FSS and Cape H	6.64	3.00		
All Breakbulk			37.70	
Maximum Containerization:				
FSS and Container	7.90			2.00
FSS, Cape H, and Container	7.90			2.00
Breakbulk and Container			29.58	2.00

*Only eight FSS vessels are currently available. Unit shipping requirements exceed the capacity of these eight vessels. Other vessels types are required to makeup the shortfall (Cape H or upcoming LMSR).
Legend:
RORO - roll on/roll off
FSS - fast sealift ship
Source: MTMCTEA report OA 90-4f-22, Deployment Planning Guide. Aug 91.

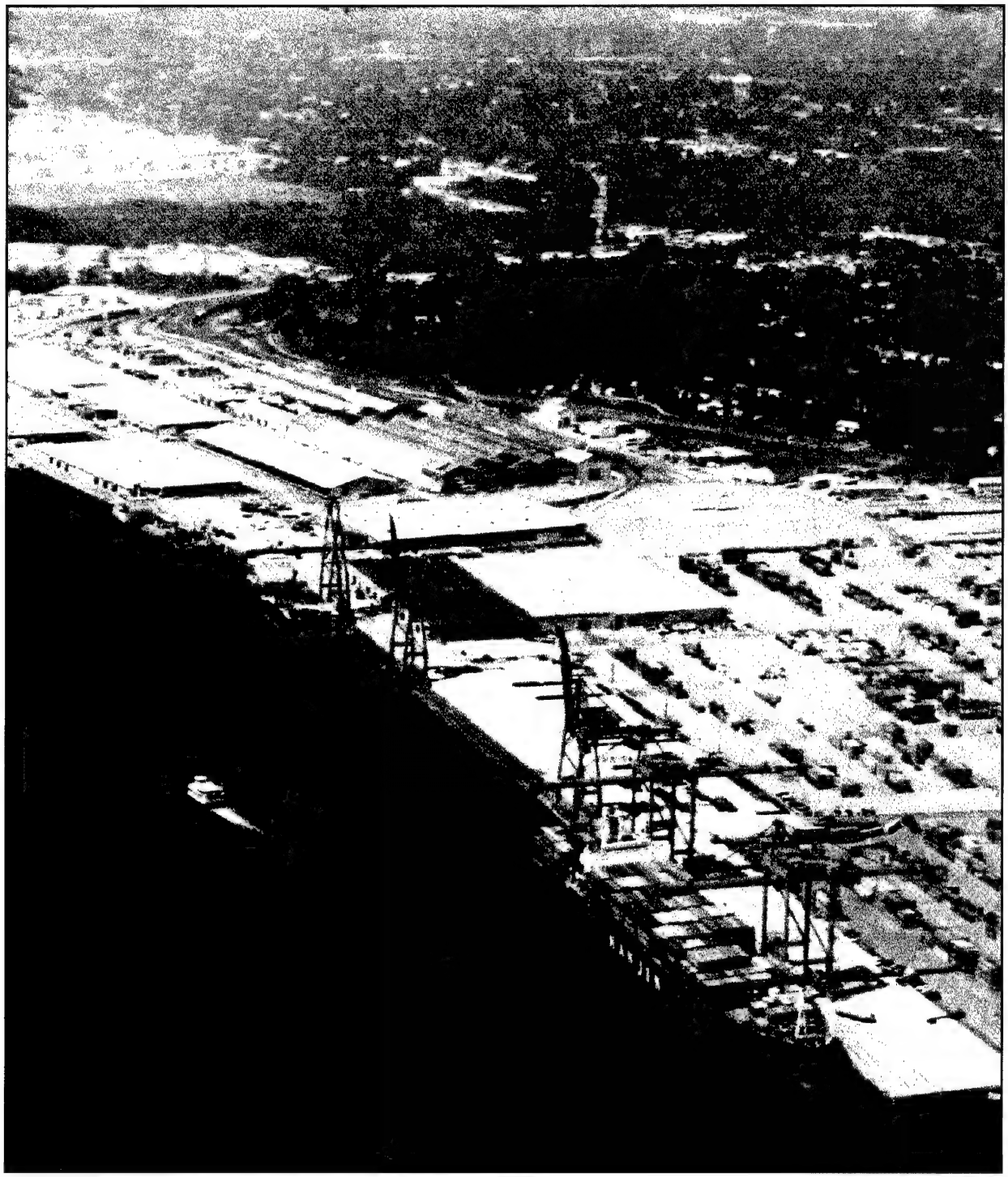
SUMMARY

The Planning Orders do not provide enough staging area to support the deployment. The port can, however, satisfy the requirement if enough staging area is available.

RECOMMENDATION

We recommend negotiating for an additional (third) FSS berth at the Garden City Terminal, 25 additional acres of open staging, and the rail spurs along warehouses 24, 25, and 26, or equivalent. At least two portable ramps will be required.

PORT 0F WILMINGTON, NC



I. GENERAL DATA

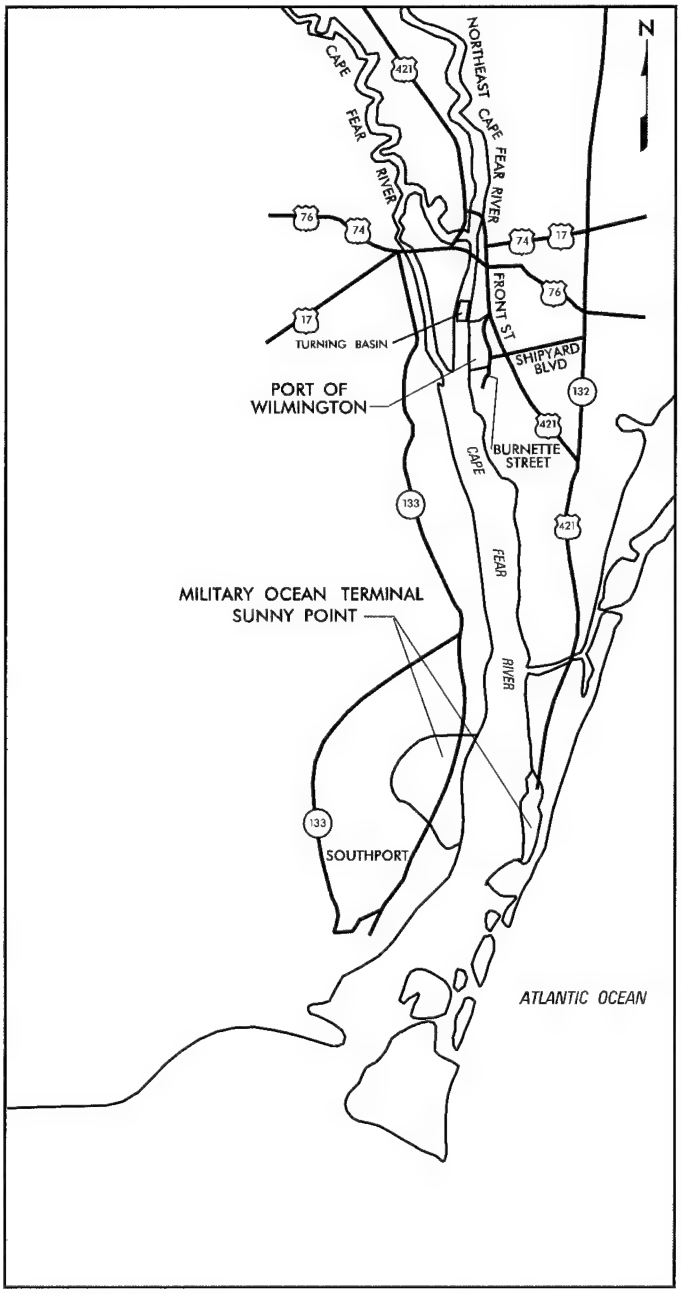
TRANSPORTATION ACCESS

Water

The Port of Wilmington, North Carolina, is on the east bank of the Cape Fear River, about 3 miles south of the junction of the Cape Fear and Northeast Cape Fear Rivers. It is 25 miles from the Atlantic Ocean and 17 miles north of Military Ocean Terminal, Sunny Point. The port lies 170 miles northeast of the Port of Charleston and 100 miles to the southwest of the Port of Morehead City.

Access to the port from the Atlantic Ocean is via a 38-foot-deep, at mean low water (MLW), and 500-foot-wide channel. The turning basin is 38 feet deep and 1,200 feet wide. Good anchorage is also available downstream in the Southport area of the river. Anchorage's are suitable for instream loading operations.

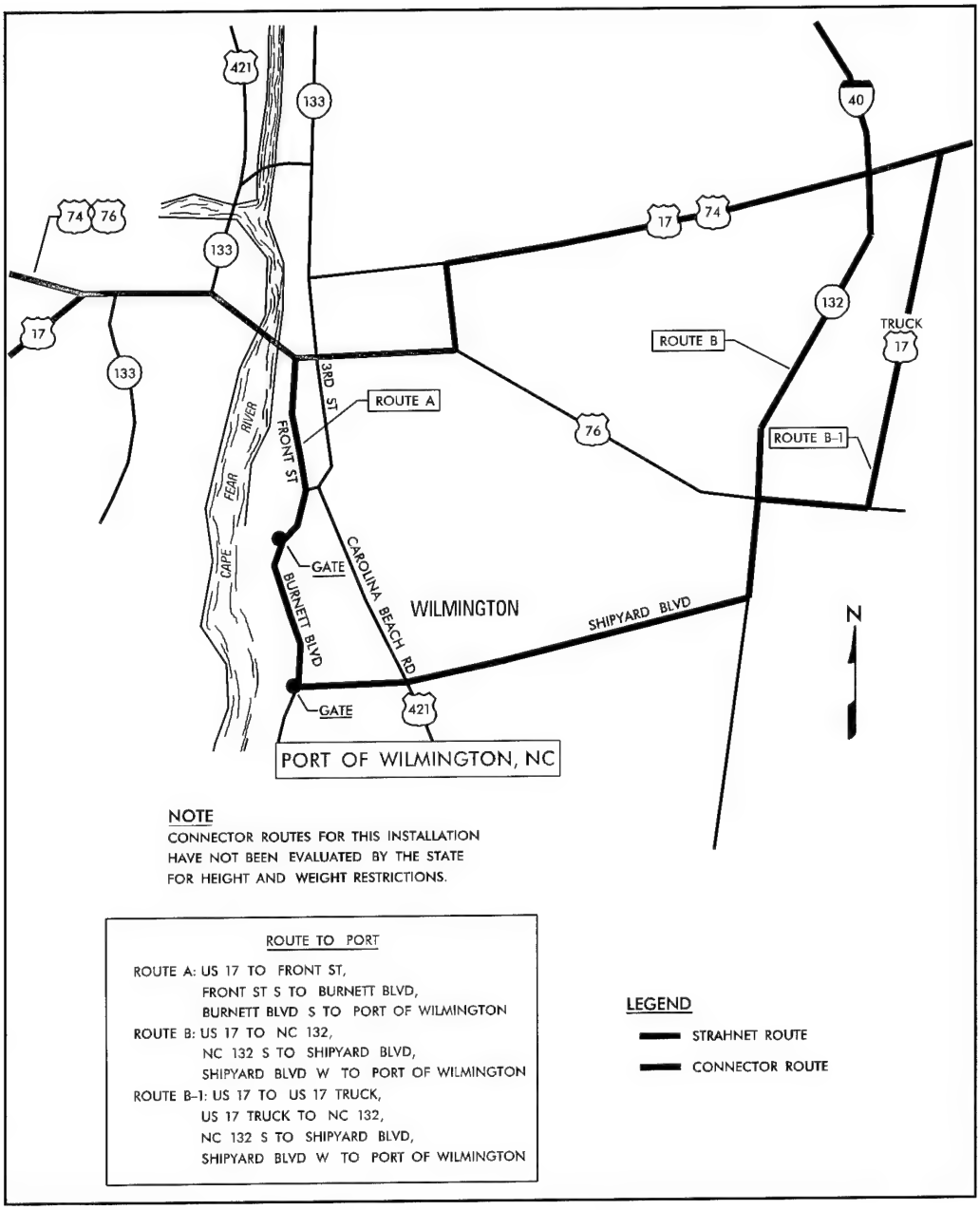
The mean tidal range at Port of Wilmington is 4.2 feet, with tidal currents averaging 1.7 knots at floodtide and 1.5 knots at ebbtide. No bridges cross the Cape Fear River downstream of the terminal. However, an overhead power cable crosses the river about 2.5 miles south of the port, thereby restricting sailing headroom to 176 feet above mean high water (MHW).



Water Access

Highway

The main highways into Wilmington are US Routes 17, 74, 76, and 421. All four highways provide good highway access to the port. Interstate 40 ends just north of Wilmington in New Hanover County and Interstate 95 is about 80 miles west of the port via US 74. Traffic coming from I-40 would continue south on US Route 132, then take Shipyard Boulevard West, which dead-ends directly into the port.



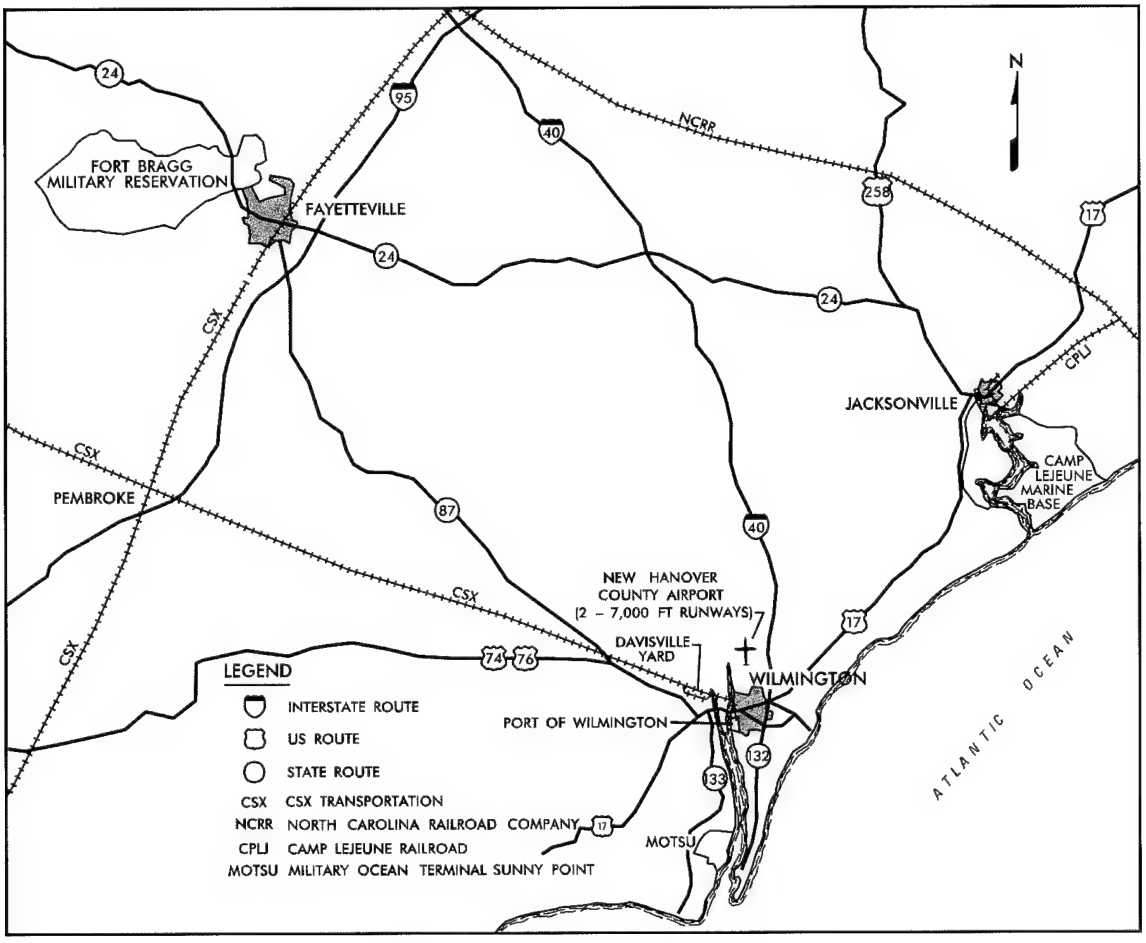
Highway Access

Rail

Rail accessibility at the Port of Wilmington is good. The CSX Railroad provides rail service to the Wilmington area. CSX normally calls on the port daily. Trackage on the terminal is owned and operated by the North Carolina Ports Railway Commission (NCPRC).

Airports

The New Hanover County Airport is about 6 miles north of the port. The airport has two major runways over 7,000 feet long. This airport routinely handles large cargo carriers and helicopters.



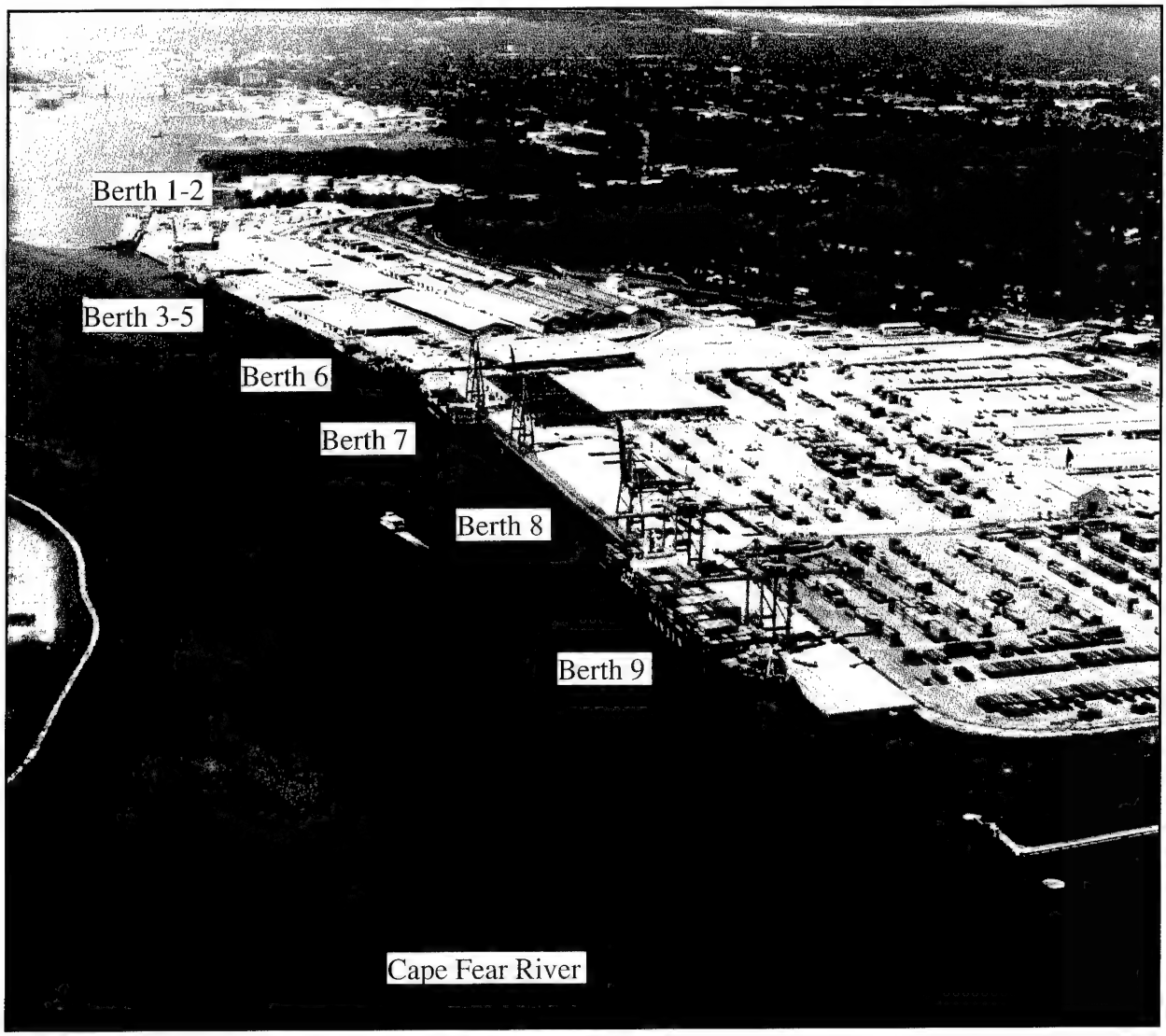
Highway, Rail and Air Access

PORT FACILITIES

Berthing

Wilmington is a multicargo port with about 6,750 feet of continuous concrete wharf. It has nine berths along the east bank of the Cape Fear River. The berths range in length from 600 to 900 feet. Dock height averages 12 feet above MLW and berth depths are 38 feet MLW. Apron widths range from 46 feet along berths 3 through 5 to 100 feet or more along the other berths.

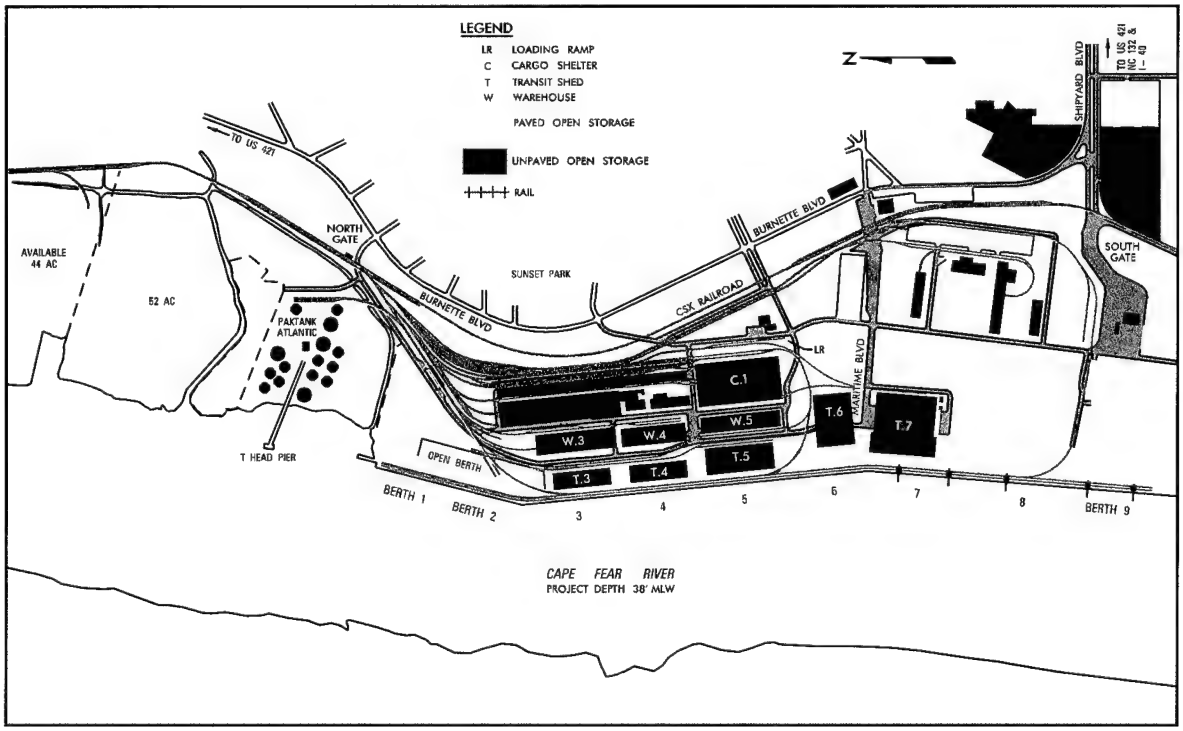
Below is an aerial view of the terminal. Also included is a land use map and a table identifying the berth characteristics.



Port of Wilmington (Northward view)

BERTHING CHARACTERISTICS OF THE PORT OF WILMINGTON

Characteristics	Berths					
	1-2	3-5	6	7	8	9
Length (ft)	1,213	2,200	700	850	900	900
Depth alongside at MLW (ft)	38	38	38	38	38	38
Deck strength (psf)	1,000	375	375	540	540	1,000
Apron width (ft)	Open	46	Open	Open	Open	Open
Apron height above MLW (ft)	12	12	12	12	12	12
Number of container cranes	0	0	1	1	1	2
Number of wharf cranes	1	2	0	0	0	0
Apron lighting	Yes	Yes	Yes	Yes	Yes	Yes
Straight-stern RORO facilities	No	No	No	No	No	No
Apron length served by rail (ft)	1,200	2,200	1,200	850	900	900



Port of Wilmington Land Use Map

Staging

Open Staging. The Port of Wilmington has about 100 acres of paved open staging and nearly 25 acres of semi-improved open storage accessible by rail or truck.

Open Staging near Berths 1-2 (Northward View)

Covered Staging. Six transit sheds and four warehouses provide a total of over 1,000,000 square feet of covered storage. Most military cargoes are worked through transit sheds 3 and 5.

Rail

Rail yards on the port have the capacity to store about 400 railcars. The nearest railyard to the port is the Davisville classification yard at Navassa, about 15 miles west of the port. This rail yard has the capacity to hold about 1,070 (89-foot) flatcars.

Unloading/loading Positions

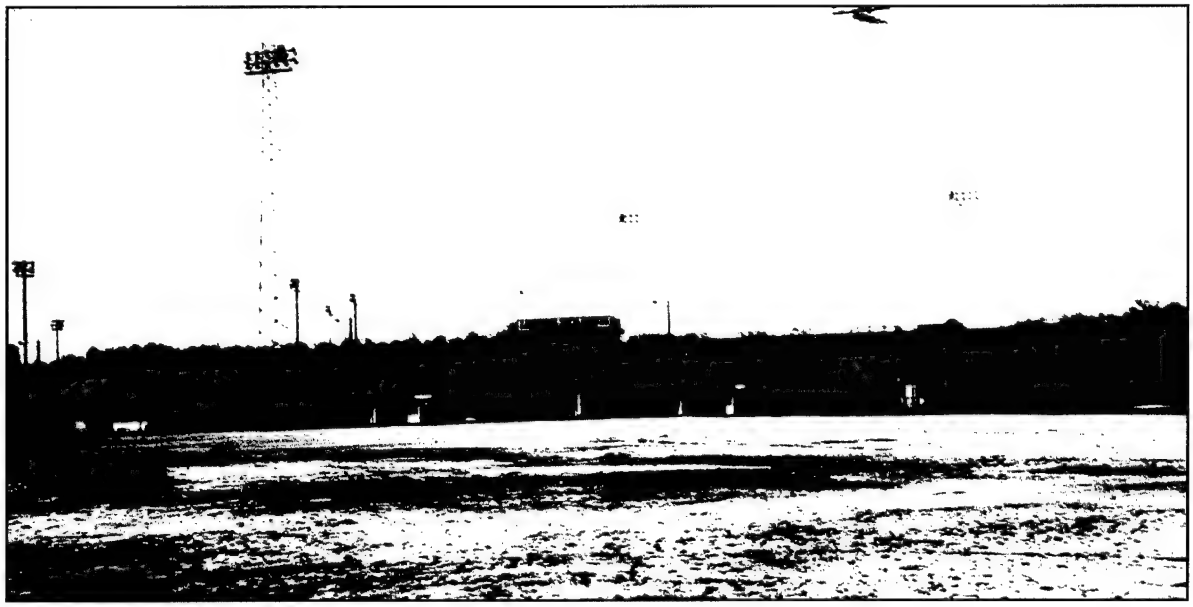
Ramps. The port has two permanent rail end ramps. One is a double loading ramp at the end of the tracks 11 and 12, each side of which will hold 12 89-foot flatcars. The other permanent ramp is at the end of track 16 and will hold five 89-foot flatcars.

Docks. Container traffic usually enters and leaves the port through the seven-lane South Gate. North Gate is used mainly for trucks carrying general cargo. Both of these gate areas have a weight scale. An Emergency Gate is located north of the South Gate on Burnett Boulevard. This gate is closed to daily traffic.

All warehouses and transit sheds have multiple depressed roadway stations for offloading. An open dock with four loading positions is available at berth 1-2 to offload trucks.

Marshaling Areas

Three sites are available near the port for marshaling areas. The Legion Stadium area, consisting of 27.5 acres, is 2 miles from the port. New Hanover County Fairgrounds has 20 unpaved acres. It is 3 miles south of Legion Stadium on Carolina Beach Road. The National Guard Armory, on North Kerr Avenue, is a 40-acre complex. It consists of a 3-story masonry building, 14 primary storage areas, and an ammunition storage area. The complex also has its own water supply treatment plant and emergency power supply.



Legion Stadium

MATERIAL HANDLING EQUIPMENT

TYPE OF EQUIPMENT	CAPACITY (STON)	QUANTITY
Wharf Cranes	15-131	3
Mobile Cranes	140	1
Top Lifts	50	9
Forklifts	2-26	65

INTERMODAL FACILITIES

The Port of Wilmington is served by both CSX Intermodal and Norfolk Southern. Both carriers operate a transparent through service between points on their nationwide networks to the Wilmington pier. Shipments are covered by one bill of lading.

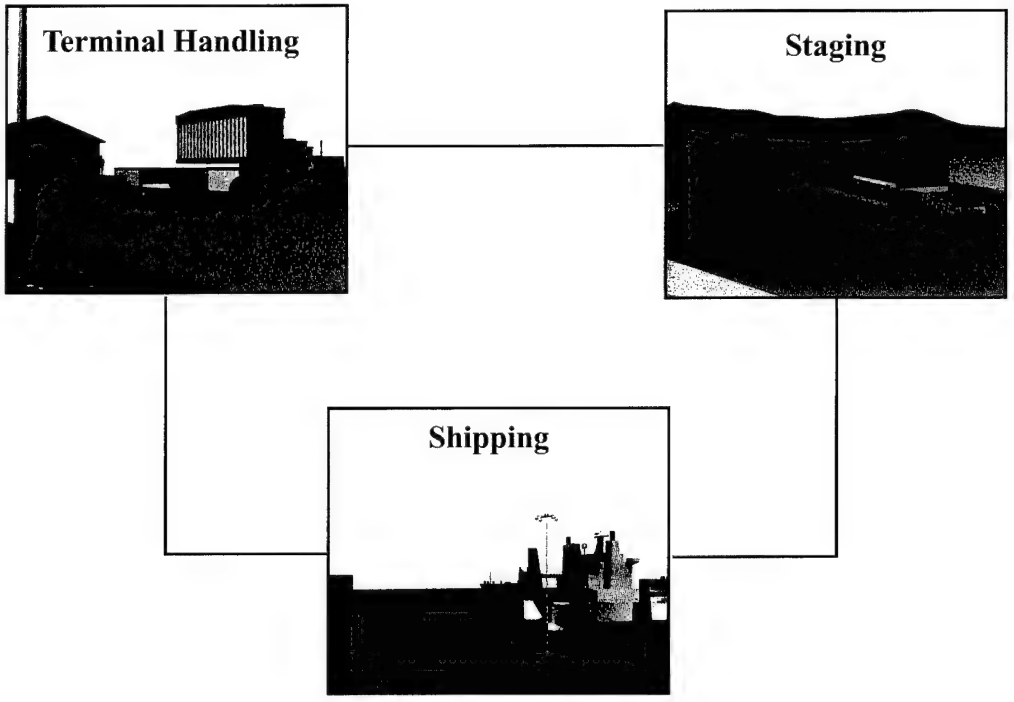
FUTURE DEVELOPMENT

The Port of Wilmington plans to expand berth 1 about 150 feet to the north. The expansion will provide 1,363 feet of continuous berth at berth 1-2 and is planned for 1996-97.

II. THROUGHPUT ANALYSIS

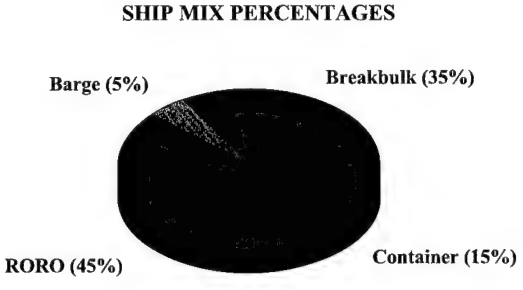
GENERAL

This section evaluates the throughput capability of the Port of Wilmington using the port operational performance simulator (POPS) computer model. The model is based on a weak link analysis in which each subsystem is analyzed separately and then compared to find the least capable subsystem. The weakest subsystem defines the maximum throughput capability of the terminal. The model yields throughput capability values for three subsystems - shipping, staging, and terminal processing/handling - in terms of measurement tons (MTON) per day.



Terminal Throughput Subsystems

This analysis assumes a maximum of 80% of the port facilities can be made available at any one time. For this reason, we ran all port analyses using an 80% facility use factor. Also, the ship mix is based on Desert Shield and Desert Storm statistics. We weighted the percentages to adjust for differences in cargo deadweights and expectations for future deployments.



RECEPTION/HANDLING

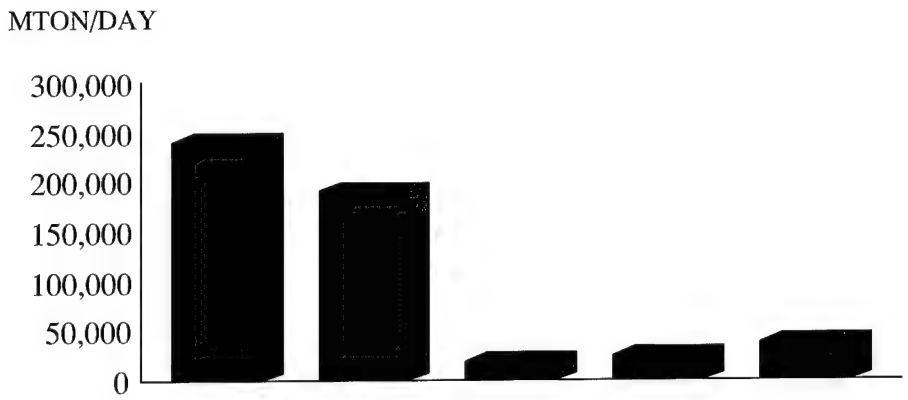
Highway

US 17, 74, 76, and 421 provide good highway access to the port. The road network into and out of the port, including the gate processing of the vehicles, could handle about 190,000 MTON of equipment and supplies per day.

Roadable vehicles in convoys will process directly to the staging areas. Vehicles on commercial or military flatbed trailers without integral ramps will offload at port ramps. The port has a permanent ramp with four handling positions at berth 1-2. This ramp could offload about 19,000 MTON from flatbed trailers per day.

Supplies in van semitrailers will proceed to the 52 van handling positions. These docks can offload over 25,000 MTON of van semitrailer-shipped material per day. Container handlers can offload about 38,000 MTON of cargo from their chassis per day.

HIGHWAY RECEPTION/HANDLING CAPABILITY



SUBSYSTEMS	HIGHWAY	GATES	END-RAMPS	DOCKS	CONTAINERS
WILMINGTON ■	240,000	190,000	19,000	25,000	38,000

Rail

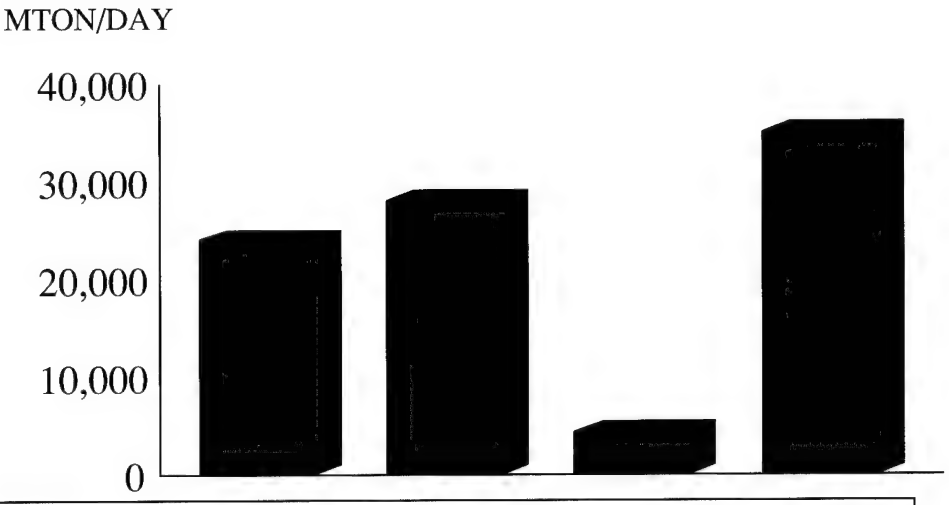
Rail clearance at the port is very good.

Railyards within the port could store about 400 railcars. Additional storage of railcars is just outside the port. This railyard can store 1,070 railcars.

Vehicles on flatcars would require end ramps to offload. The port has two fixed concrete end ramps. The fixed end ramps support a total of 1,700 feet of track.

Terminal	Train Length (railcars)	Trains Per Day
Wilmington	29	9

RAIL RECEPTION/HANDLING CAPABILITY



SUBSYSTEMS	TRACKAGE	END-RAMPS	DOCKS	COFC
WILMINGTON	24,000	28,000	4,300	35,000

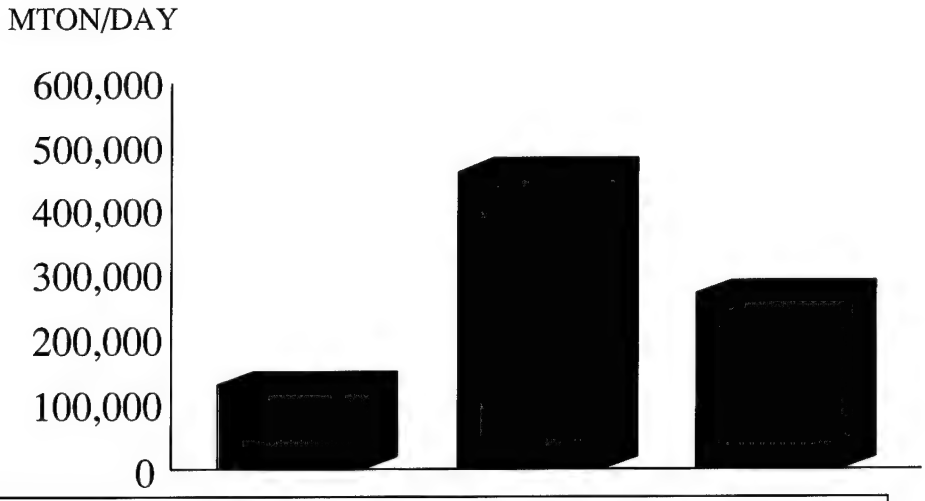
STAGING

The port has about 100 acres of paved open storage and nearly 25 acres of semi-improved open storage accessible by rail or truck.

The port has six covered transit sheds totaling 647,000 square feet. Most military cargoes are worked through transit sheds 3 and 5.

The port can perform operations on container or breakbulk ships. The cargo mix depends on the anticipated vessel type. For example, cargo will be containerized if a container ship is planned. The chart below provides the staging capability for the cargo for each of these vessel types. If a combination ship is expected, then a portion of each involved capability should be assumed.

OPEN STAGING CAPABILITY

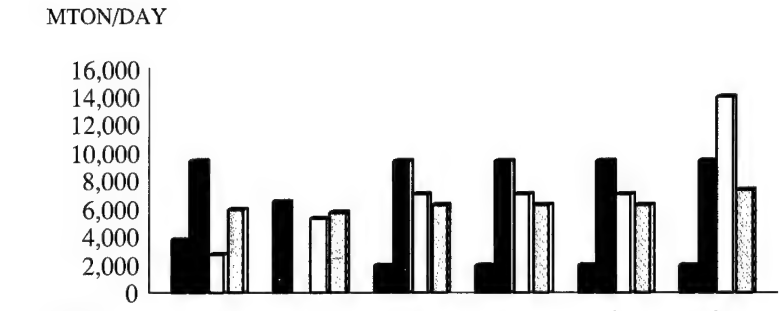


VESSEL TYPE	RORO	CONTAINERS	BREAKBULK
WILMINGTON ■	130,000	460,000	270,000

SHIPPING

Throughputs for each berth are shown below. They are based on various factors, including MHE used; loading, operational, and berth usage rates; and berthing capabilities for various vessel types. Appendix A shows the values used for these factors.

BERTH THROUGHPUT CAPABILITY



BERTH	1-2	3-5	6	7	8	9
BREAKBULK	3,800	6,500	1,900	1,900	1,900	1,900
RORO	9,400	0	9,400	9,400	9,400	9,400
CONTAINER	2,700	5,300	7,000	7,000	7,000	14,000
MIXED	6,000	5,700	6,300	6,300	6,300	7,400

CONVERSION FACTORS	
Breakbulk:	.4 STON per MTON
RORO:	.25 STON per MTON
Container:	.4 STON per MTON

The type of ship preferred at each berth is based on the methodology described in the Appendix. The evaluation is based on a snapshot view of the current physical characteristics of the berths and the MHE available. The evaluation below gives no considerations for enhancements, such as equipment. The lower the number for a berth, the better the berth is suitable for the loading operation.

PREFERENCE BERTH SELECTION			
BERTH	**BB**	**RORO**	**CNTNR**
1-2	1	4	5
3-5	2	-	4
6	6	-	6
7	3	2	2
8	3	2	2
9	3	1	1

SUMMARY OF BERTHING CAPABILITIES

Vessel	Berths			
	1-2	3-4	5-6	7-9
Breakbulk				
C3-S-33a	2	3	2	5
C3-S-37c2	2	3	2	5
C3-S-37d	2	3	2	5
C3-S-38a	2	3	2	5
C4-S-1a	2	3	2	4
C4-S-1qb and 1u	2	3	2	4
C4-S-58a	2	3	2	4
C4-S-65a	2	3	2	4
C4-S-66a	2	3	2	4
C4-S-69b	2	2	1	4
Seatrain				
GA and PR-class	2	3	2	4
Barge				
LASH C8-S-81b	1	2	1	3
LASH C9-S-81d	1	1	1	2
LASH lighter	8	12	8	18
SEABEE C8-S-82a	a,g	a,g	a,g	a,g
SEABEE barge	6	9	6	13
RORO				
Comet	d,i,j	d,o	d,i,j	d,i,j
C7-S-95a/Maine-class	1	b	1	3
Ponce-class	h	b,h	h	h
Great Land-class	h	b,h	h	h
Cygnus/Pilot-class	1	b	1	4
Meteor	d,i,j	d,o	d,i,j	d,i,j
AmEagle/Condor	i,j	b	i,j	i,j
MV Ambassador	d	d	d	d
FSS-class	1	b	1	2
Cape D-class	i,j	b	i,j	i,j
Cape H-class	1	b	1	3
LMSR	1	b	1	2
Container				
C6-S-1w	1,e	2,e	1	3
C7-S-68e	1,e	2,e	1	3
C8-S-85c	1,e	2,e	1	3
Combination				
C5-S-78a	1,e	2,e	1	4
C5-S-37e	1,e	2,e	1	4

a=vessel draft limited to berth depth
b=inadequate apron width
c=inadequate berth length
d=no straight stern-ramp facilities
e=no container-handling equipment
f=shallow berth, adequate anchorage depth
g=inadequate channel depth
h=no shore-based ramps available
i=insufficient ramp clearance at low tide
j=insufficient ramp clearance at high tide
k=excessive ramp angle at low tide
m=excessive ramp angle at high tide
n=parallel ramp operation only
o=too narrow apron for side-ramp

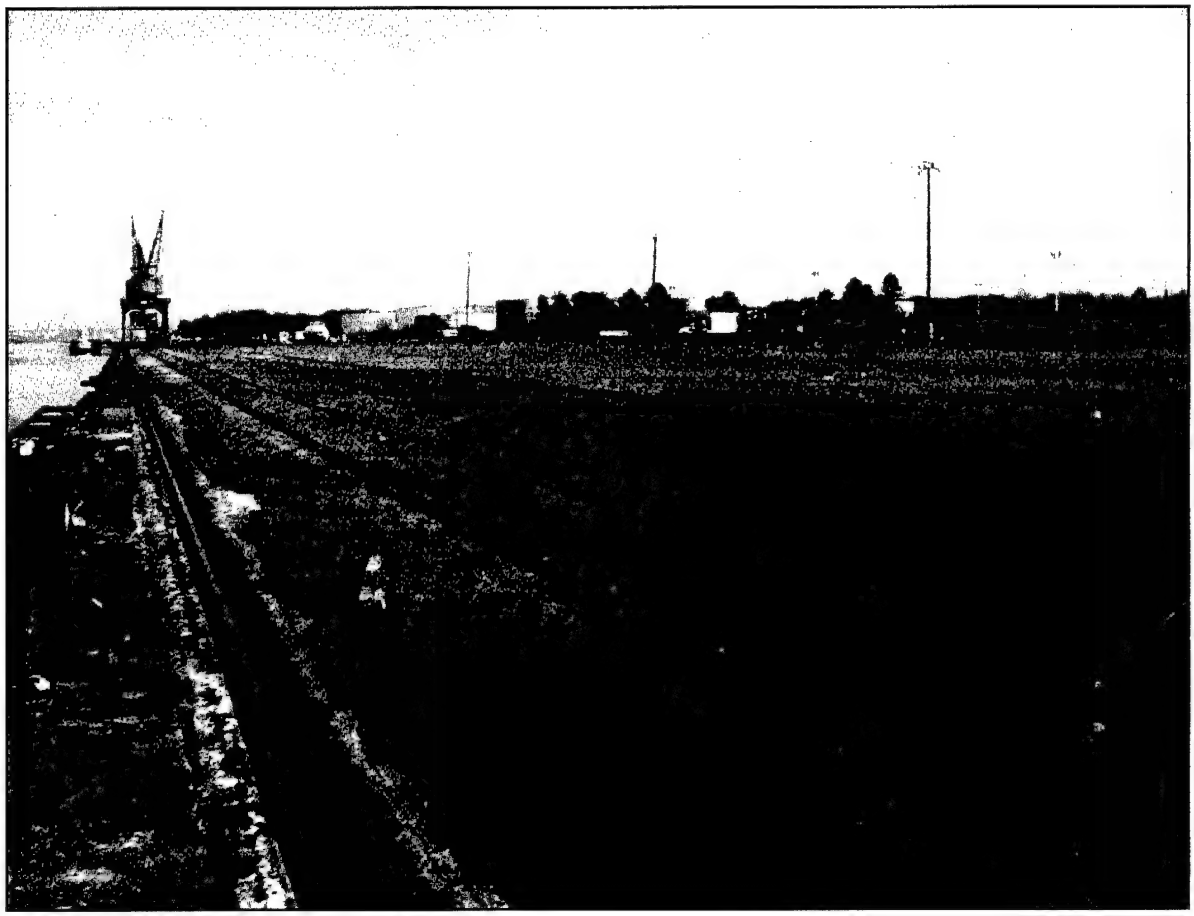
Notes: Ramp clearance and ramp angle based on maximum vessel draft
( ) indicates vessels assigned by analyst

III. APPLICATION

GENERAL

This section of the report will evaluate the port's throughput capability for deploying a notional mechanized infantry division using primarily FSS vessels.

The August 1994 revision for the ***Planning Orders Digest***, issued by MARAD, provided agreements for military use of the Port of Wilmington. The agreement referenced berths 1-2 and 6, the north half of transit shed 3, transit shed 5, and 28 acres of staging area. The planning order revision of August 1995 supports the MARAD facility requirements without identifying specific berths, sheds or staging areas. The revision identifies three berths, transit sheds 3 and 5, and 25 acres of staging and loading space at the Port of Wilmington for *PRIORITY* and *EXCLUSIVE USE* for military deployments. If the military needs to deploy through the Port of Wilmington, it will most likely use berths 1 and 2 or berths 7-9.



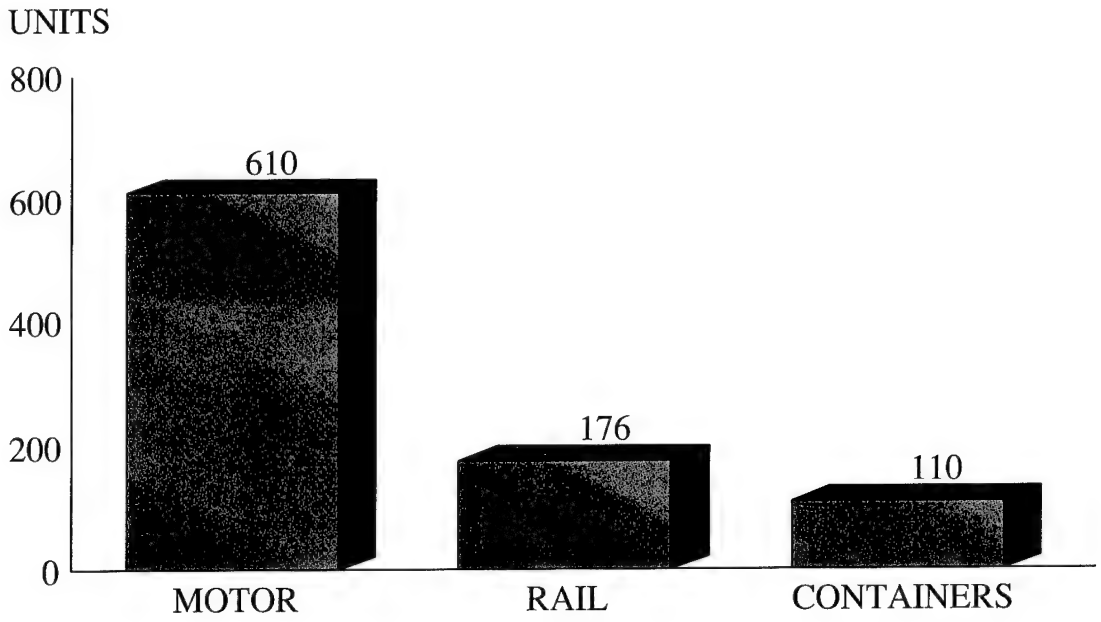
Berths 1 and 2 (Northward view)

REQUIREMENTS

The likely requirement for the Port of Wilmington is to deploy a notional mechanized infantry division in six days of reception and throughput. The division has to move about 7,800 vehicles and 660 containers. The movement to the port will require 1,055 (176 per day) railcars using the convoy/rail option. Under this option, about 3,650 (610 per day) roadable vehicles would be driven and about 2,320 (387 per day) would be towed.

MECHANIZED INFANTRY DIVISION	
Total Equipment	
Volume	280,000 MTON
Weight	95,000 STON
Area	1,400,000 SQ FT
Vehicles	7,800
Containers	660

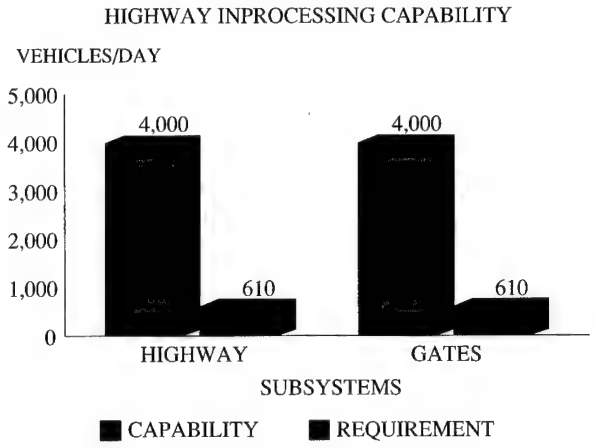
DAILY REQUIREMENTS

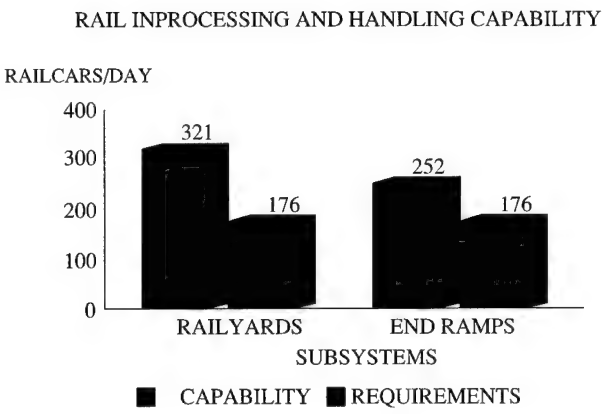


TERMINAL INPROCESSING/HANDLING

Highway

Vehicles and containers on chassis would access the terminals through the South or North Gates. Both gates are located on Burnett Boulevard. The access roads and gates can handle well over 4,000 vehicles per day.





Rail

Rail reception at the Port of Wilmington is good. CSX normally calls on the port nine times daily. Trackage on the terminal is owned and operated by the North Carolina Ports Railway Commission (NCPRC).

The nearest classification yard is the Davisville yard at Navassa, about 15 miles west of the port. This railyard has capacity to hold about 1,070 (89-foot) flatcars. Using a railyard usage factor of 70 percent leaves an available storage capability of 321 railcars. This capability exceeds the 176 cars per day rail requirement.

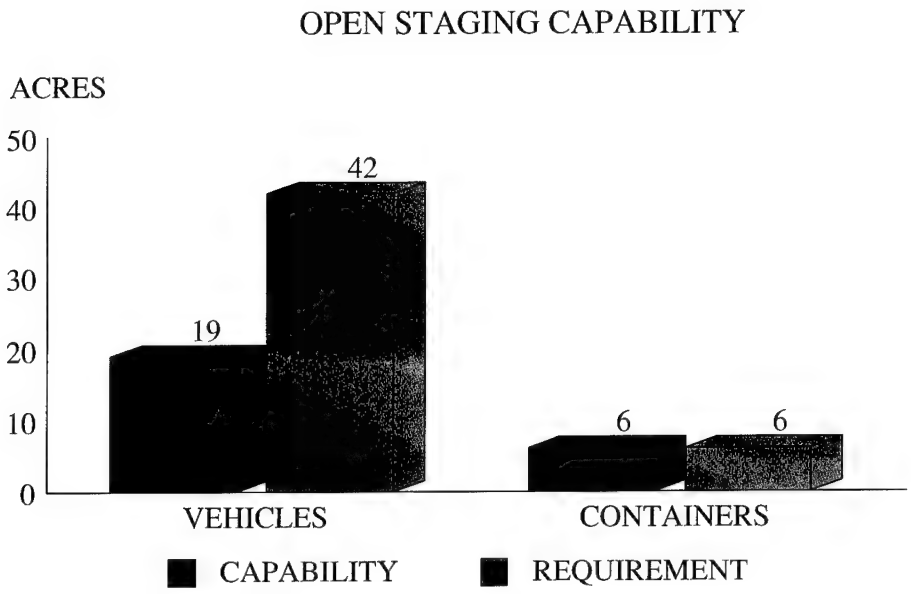
The port has two permanent rail end ramps. One of the ramps is a double loading ramp on the end of tracks 11 and 12, which will hold 12 (89-foot) railcars each. The other permanent ramp is at the end of track 16. It will hold five (89-foot) railcars. Tracks 10 and 13 both require the use of portable end ramps and will hold 14 and 20 (89-foot) railcars, respectively. Using all five offloading sites the port could handle a total of 63 flatcars per cycle. Therefore, it could reasonable offload 252 flatcars by accomplishing four cycles per day. This exceeds the requirement of 176 railcars per day.

STAGING

This analysis assumes that current downsizing continues, and that nine FSS-sized ships will deploy an entire notional mechanized infantry division. Three ships will depart every 2 days. Because of this, the staging requirement is to support three sustained loading operations.

Although an FSS-load of cargo can be staged and loaded on 10 acres, 16 acres are required for sustained loading operations. Of these 16 acres, about 2 acres are required for the staging of the 73 containers for each FSS. The three simultaneous ship loading operations will require 48 acres of open staging, of which about 6 acres are dedicated to containers.

The Port of Wilmington contains about 100 acres of open staging area. The Planning Orders, however, only provide for 25 open acres of staging. This is not sufficient to meet the requirement of 48 acres.

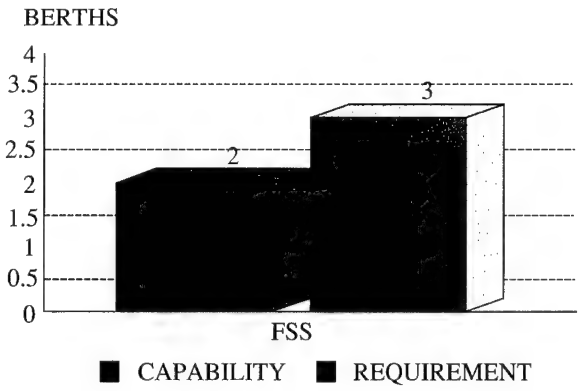


SHIPPING

Although this analysis assumes that only nine FSS-sized ships can deploy the notional mechanized infantry division, the table below provides ship quantities for the current division size. The number of ships required depends on the shipping mix selected. The best ship mix would consist of all eight FSS ships, plus two Cape H RORO ships.

Although the current Planning Orders provide for three berths, the military can expect to berth only two FSS-sized vessels. This does not meet the requirement to berth three FSS-sized vessels.

FSS SHIPPING CAPABILITY



UNIT MOVEMENT REQUIREMENTS
MECHANIZED DIVISION

Loading Condition/Sample Ship Mix	Vessel Types			
	FSS (RORO/Comb)	Cape H (RORO/Comb)	C3/C4 (Breakbulk)	C6/C7/C8 (Container)
Minimum Containerization:				
All FSS*	8.00	1.90		
FSS and Cape H	6.64	3.00		
All Breakbulk			37.70	
Maximum Containerization:				
FSS and Container	7.90			2.00
FSS, Cape H, and Container	7.90			2.00
Breakbulk and Container			29.58	2.00

Only eight FSS vessels are currently available. Unit shipping requirements exceed the capacity of these eight vessels. Other vessels types are required to makeup the shortfall (Cape H or upcoming LMSR).

Legend:
RORO - roll on/roll off
FSS - fast sealift ship

Source: MTMCTEA report OA 90-4f-22, Deployment Planning Guide. Aug 91.

SUMMARY

The Planning Orders for the Port of Wilmington are insufficient to meet the requirement of deploying a mechanized infantry division with 6 days of ship loading. Depending on the availability of the fixed rail end ramps, one or two portable end ramps may be required.

RECOMMENDATION

We recommend the Planning Orders for the Port of Wilmington be revised to include 23 additional acres of staging and another berth for FSS-sized vessel operations. The military port operator should plan to acquire at least one portable rail end ramp.

APPENDIX A

THROUGHPUT PARAMETERS

SHIP OPERATIONAL RATES	STON/HR	MTON/HR
Breakbulk Rates		
Ship Crane	15.0	37.5
Dockside Cranes	20.0	50.0
Barge	20.0	50.0
RORO Rates	200.0	800.0
Container Lift Rates	21.0 Lifts/Hr Container Crane	8.0 Lifts/Hr Wharf Crane
Berth Utilization Factor= 0.8		

Ship Mix Percentages	%
BreakBulk	35.0
Barge	5.0
RORO	45.0
Container	15.0

Minimum Mobile-Crane Size	STON
Breakbulk	40.0
Barge	20.0
Container	100.0

Ship Cargo Mix			
	Breakbulk	RORO	Container
Roadable Vehicles	43%	90%	-
Nonroadable Vehicles	7%	10%	-
Container	15%	-	100%
Noncontainer	35%	-	-

Staging Data:	
Staging Dwell Time	3 Days
Space Utilization Factor	
Open	60%
Covered	60%
Facility Use Factor	80%

Stacking Height	Feet
Open - General	24
Covered	10
Open - Vehicle	7.6

Motor Vehicle Parameters	STON	MTON
Convoy	3.5	17.0
Flatbed	20.0	60.0
Van	16.0	40.0
Chassis	16.0	40.0
Railcar Parameters	STON	MTON
Flatcar	50.0	150.0
Boxcar	30.0	75.0
COFC	24.0	60.0
Container (TEU) Capacity	8.0	20.0

Truck Handling Rates	Trucks/Hr
End Ramps	4.0
Van Docks	1.0
Railcar Handling Rates	Railcars/Hr
End Ramps	4.0
Boxcar Docks	0.3
Length of Flatcars	95 Feet
Productive Work Hours	20 Hours

Mode Mix	%	%
Roadable Veh: Convoy/Flatcar	90	10
Nonroadable Veh: HETs/Flatcars	10	90
General Cargo:		
Van/Box	35	15
Flatbed/Flatcar	35	15
Container:		
Chassis/COFC	75	25

APPENDIX B

BERTH EVALUATION METHODOLOGY

GENERAL

This appendix provides a technique for accomplishing a comparative analysis of individual berths. The first step is to evaluate the individual berths within a port to determine their potential for breakbulk, RORO, and container vessel operations.

INDIVIDUAL BERTH EVALUATION

For the individual berth evaluation, a comparison is made of the characteristics of each berth and the list of ideal factors required to support the different ship mixes. Tables B-1 through B-3 give the ideal factors for breakbulk, RORO, and containership mix operations. As the tables show, points are awarded for each factor. These are then used to compare the potential for each factor. These are then used to compare the potential of each berth to support the three ship mixes. A ranking of individual berths is established for each type of ship mix operation, based on a comparison of total points accumulated by each berth.

The berth receiving the highest accumulation of points is assigned a value of 1, and the remaining berths are ranked accordingly.

TABLE B-1
IDEAL BREAKBULK BERTH FACTORS

Berth Factor	Points	Berth Factor	Points
Berth Type		**Transit Shed**	
Quay or marginal	10	Available	15
Pier	7	None	0
Berth Length (ft)		**Deck Strength (lb per ft^2)**	
Greater than 750	20	Greater than 800	10
700 to 750	18	600 to 800	9
600 to 699	16	400 to 599	5
500 to 599	10	Less than 400	2
Less than 500	5		
Water Depth (ft) MLW		**Ship Service Facilities**	
Greater than 35.0	20	Power, water, and telephone	6
32.0 to 35.0	18	Power and water	5
30.0 to 31.9	16	Water only	4
28.0 to 29.9	14	None	0
Less than 28.0	12		
Apron Width (ft)		**Cranes**	
20.0 or greater	15	Wharf	10
Less than 20.0	5	Heavy-lift mobile ($\geq$ 100 STON)	9
		Mobile	5
		None	0
Apron Tracks		**Conditional Age**	
2	10	New	10
1	7	10 years old	8
None	0	20 years old	4
		30 years old	1

TABLE B-2
IDEAL RORO BERTH FACTORS

Berth Factor	Points	Berth Factor	Points
Berth Type		**Apron Tracks**	
Quay or marginal	10	2	10
Pier	5	1	7
		None	0
Berth Length (ft)		**Deck Strength (lb per ft^2)**	
Greater than 1,000	20	Greater than 800	10
900 to 1,000	18	600 to 800	9
800 to 899	16	400 to 599	5
700 to 799	10	Less than 400	2
600 to 699	6		
Less than 600	2		
Water Depth (ft) MLW		**Ship Service Facilities**	
Greater than 35.0	20	Power, water, and telephone	6
32.0 to 35.0	18	Power and water	5
30.0 to 31.9	16	Water only	4
28.0 to 29.9	14	None	0
Less than 28.0	12		
Apron Width (ft)		**Vehicle Access**	
Greater than 60.0	20	Uncongested	10
40.0 to 60.0	15	Congested	5
30.0 to 39.9	5		
Less than 30.0	0		
RORO Ramp Operation		**Conditional Age**	
Side, slewed, straight	10	New	10
Side, slewed-stern	6	10 years old	8
Slewed-stern	4	20 years old	4
Starboard-slewed-stern	2	30 years old	1
None	0		
Tidal Range (ft)			
0 to 3.9	10		
4.0 to 7.9	8		
8.0 to 11.9	6		
12.0 to 16.0	4		
Greater than 16.0	0		

TABLE B-3
IDEAL CONTAINER BERTH FACTORS

Berth Factor	Points	Berth Factor	Points
Berth Type		**Deck Strength (lb per ft^2)**	
Quay or marginal	10	Greater than 1,000	10
Pier	5	800 to 999	8
		600 to 799	5
		400 to 599	3
		Less than 400	1
Berth Length (ft)		**Ship Service Facilities**	
Greater than 1,000	20	Power, water, and telephone	6
900 to 1,000	18	Power and water	5
800 to 899	16	Water only	4
700 to 799	10	None	0
600 to 699	6		
Less than 600	2		
Water Depth (ft) MLW		**Container Cranes**	
Greater than 40.0	20	Specialized container crane	20
35.0 to 40.0	18	Mobile gantry	16
32.0 to 34.9	16	Mobile crane (200-ton)	12
30.0 to 31.9	14	Mobile crane (100-ton)	8
Less than 28.0	12	None	0
Apron Width (ft)		**Container Handling Equipment**	
Greater than 60.0	20	Straddle cranes	10
40.0 to 60.0	15	Straddle trucks	9
30.0 to 39.9	5	Front/side-loading forklifts	8
20.0 to 29.9	2	Mobile cranes	5
Less than 20.0	1	None	0
Apron Tracks		**Conditional Age**	
2	10	New	10
1	7	10 years old	8
None	0	20 years old	4
		30 years old	1
Consolidated Shed			
Available	10		
None	0		

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